

# NUCLEAR SCIENCE ABSTRACTS

Vol. 8, No. 4, February 28, 1954

## TABLE OF CONTENTS

Category	Abstract	Page	Category	Abstract	Page
CALENDAR OF MEETINGS		iv	MINERALOGY, METALLURGY, AND CERAMICS		
SELECTED SUBJECTS OF INTEREST TO INDUSTRY		v	Corrosion	1079	
GENERAL	968	115	Geology and Mineralogy	1080	
BIOLOGY AND MEDICINE	970	115	Metals and Metallurgy	1086	
Radiation Effects	973		PHYSICS	1113	132
Radiation Hazards and Protection	987		Aerosols	1128	
Toxicology Studies	990		Cosmic Radiation	1130	
Tracer Applications	994		Instruments	1134	
CHEMISTRY	999	119	Isotopes	1143	
Analytical Procedures	1009		Isotope Separation	1145	
Crystallography and Crystal Structure	1032		Mass Spectrography	1146	
Fluorine and Fluorine Compounds	1033		Mathematics	1147	
Graphite	1038		Measuring Instruments and Techniques	1149	
Laboratories and Equipment	1039		Mesons	1171	
Radiation Chemistry	1041		Meteorology	1181	
Radiation Effects	1044		Molecular Properties	1183	
Rare Earths and Rare-earth Compounds	1046		Neutrons	1185	
Separation Procedures	1049		Nuclear Physics	1188	
Sorption Phenomena	1054		Nuclear Properties	1200	
Syntheses	1057		Nuclear Reactors	1207	
Transuranic Elements and Compounds	1058		Nuclear Transformation	1212	
Tritium and Tritium Compounds	1060		Particle Accelerators	1217	
Uranium and Uranium Compounds	1061		Radiation Absorption and Scattering	1227	
ENGINEERING	1064	126	Radioactivity	1241	
Heat Transfer and Fluid Flow	1064		Rare Earths and Rare-earth Compounds	1255	
Materials Testing	1071		Shielding	1256	
Vacuum Systems	1072		Spectroscopy	1258	
MINERALOGY, METALLURGY, AND CERAMICS	1074	127	Theoretical Physics	1264	
Ceramics and Refractories	1074		Uranium and Uranium Compounds	1274	
			AUTHOR INDEX		INDEX-1
			NUMERICAL INDEX OF REPORTS		INDEX-6

## CALENDAR OF MEETINGS

Suggestions for additions to this list will be welcomed and should be sent with all pertinent information to the Cataloging Branch, Technical Information Service, U. S. Atomic Energy Commission, P. O. Box 62, Oak Ridge, Tennessee.

March 4-5, 1954

ASM CONFERENCE ON METAL BERYLLIUM, Hotel Statler, Boston, Massachusetts. Sponsored by: American Society for Metals. General Chairman: D. W. White.

Inquiries should be addressed to: Mr. E. E. Thum, American Society for Metals, 7301 Euclid Avenue, Cleveland 3, Ohio, or Mr. D. W. White, General Electric Company, Knolls Atomic Power Laboratory, Schenectady, New York.

March 15-19, 1954

ELEVATED TEMPERATURE CORROSION SYMPOSIUM, Municipal Auditorium, Kansas City, Mo. Sponsored by: National Association of Corrosion Engineers-10th Annual Conference

Inquiries should be addressed to: Glenn A. Fitzlen, Ass't. Technical Director, Haynes Stellite Company, Kokomo, Indiana.

June 20-25, 1954

NUCLEAR ENGINEERING CONFERENCE, University of Michigan, Ann Arbor, Michigan, Sponsored by: American Institute of Chemical Engineers.

Inquiries should be addressed to: Professor Donald Katz, University of Michigan, Department of Engineering, Ann Arbor, Michigan.

July 19-24, 1954

SECOND RADIOISOTOPE CONFERENCE (a conference on the peaceful uses of atomic energy), Oxford, England, Arranged by: The Atomic Energy Research Establishment, Harwell.

Inquiries should be addressed to: The Conference Secretary, Atomic Energy Research Establishment, Harwell, Didcot, Berks, England.



## SELECTED SUBJECTS OF INTEREST TO INDUSTRY

All AEC reports abstracted in this issue of Nuclear Science Abstracts have been reviewed and evaluated in terms of their interest and usefulness to general industry. These reports are listed below by title, author, and report number under one or more of the following nine broad categories: Chemistry and Chemical Engineering; Construction and Civil Engineering; Electronics and Electrical Engineering; Health and Safety; Industrial Management; Mechanics and Mechanical Engineering; Metallurgy and Ceramics; Mining and Geology; and Nuclear Technology. The abstract number for each report is listed at the upper right of the entry and refers to an item in the current issue of NSA.

All unclassified reports considered to be of special interest to general industry issued by the AEC prior to July, 1953 are listed or abstracted in a series of bibliographies (TID-3050), the titles of which correspond to the above-mentioned categories. As these background bibliographies become available for sale, the prices will appear in the Numerical Index of Reports which is included in each issue of this volume of NSA. These bibliographies may be purchased from the U. S. Department of Commerce, Office of Technical Services, Washington 25, D. C.

Reproduction in whole or part of any report listed herein is encouraged by the United States Atomic Energy Commission, subject to the approval of authors or originating sites. General inquiries from the industrial press about AEC-developed information may be directed to the Industrial Information Branch, AEC, Washington 25, D. C.

### CHEMISTRY AND CHEMICAL ENGINEERING

KAPL-974 1073  
Knolls Atomic Power Lab.  
STATIC SEAL STUDIES. W. A. Heywood. June 1953. 55p.  
Contract W-31-109-eng-52. (KAPL-974)

LRL-65 1054  
Livermore Research Lab., Calif. Research and Development Co.  
THE QUALITATIVE ANIONIC BEHAVIOR OF A NUMBER OF METALS WITH AN ION EXCHANGE RESIN, "DOWEX 2." H. G. Hicks, R. S. Gilbert, P. C. Stevenson, and W. H. Hutchin. Issued Dec. 1953. 10p. Contract AT(11-1)-74. (LRL-65)

ORNL-1604 1069  
Oak Ridge National Lab.  
UNSTEADY STATE FLOW OF STEAM FROM A HIGH PRESSURE SYSTEM. Wayne S. Brown. Issued Dec. 10, 1953. 60p. Contract W-7405-eng-26. (ORNL-1604)

UCRL-2394 1057  
Radiation Lab., Univ. of Calif., Berkeley  
PREPARATION OF DIETHYL MALONATE-2-C<sup>14</sup>. Doris Chin and Patricia Adams. Nov. 1953. 12p. Contract W-7405-eng-48. (UCRL-2394)

### ELECTRONICS AND ELECTRICAL ENGINEERING

ORNL-1648 1128  
Oak Ridge National Lab.  
THE DIFFUSION BATTERY METHOD FOR AEROSOL PARTICLE SIZE DETERMINATION. Jess W. Thomas. Issued Jan. 5, 1954. 68p. Contract W-7405-eng-26. (ORNL-1648)

### HEALTH AND SAFETY

AECU-2775 994  
Los Alamos Scientific Lab.  
THE METABOLISM OF C<sup>14</sup> LABELED ETHYLENEDIAMINE-TETRAACETIC ACID IN HUMAN BEINGS. Harry Foreman and Theodore T. Trujillo. [1953]. 13p. Contract W-7405-eng-36. (AECU-2775)

ANL-5111 974  
Argonne National Lab.  
ANNOTATED BIBLIOGRAPHY IN RADIOBIOLOGY. Sophie V. Stephens, Argonne National Lab. and Robert D. Boche, Air Force Radiation Lab., Univ. of Chicago, comps. [1953] 367p. (ANL-5111)

UR-252 990  
Atomic Energy Project, Univ. of Rochester  
A COMPARATIVE STUDY OF THE INHIBITORY ACTIONS OF MERCURY AND URANIUM ON YEAST AND YEAST HEXOKINASE. Leon Hurwitz. Oct. 22, 1953. 100p. Contract W-7401-eng-49. (UR-252)

### MECHANICS AND MECHANICAL ENGINEERING

GEL-77 1071  
General Engineering Lab., General Electric Co.  
COLLISION OF PLATES. H. Poritsky and M. F. Bolster. Nov. 1, 1953. 31p. Contract W-31-109-eng-52. (GEL-77; R53GL226)

ORNL-1604 1069  
Oak Ridge National Lab.  
UNSTEADY STATE FLOW OF STEAM FROM A HIGH PRESSURE SYSTEM. Wayne S. Brown. Issued Dec. 10, 1953. 60p. Contract W-7405-eng-26. (ORNL-1604)

## METALLURGY AND CERAMICS

- AECD-3602 1086  
Ames Lab.  
THE THORIUM-VANADIUM SYSTEM. H. L. Livingston  
and B. A. Rogers. Apr. 22, 1953. Decl. with deletions  
Nov. 16, 1953. 20p. Contract W-7405-eng-82. (AECD-  
3602; ISC-340)
- AECD-3603 1087  
Ames Lab.  
THORIUM-TITANIUM ALLOY SYSTEM. H. A. Wilhelm,  
O. N. Carlson, and H. E. Lunt. June 1953. Decl. with  
deletions Dec. 2, 1953. 22p. Contract W-7405-eng-82.  
(AECD-3603; ISC-408)
- ISC-341 1117  
Ames Lab.  
SOME STUDIES ON THE DIFFUSION OF SODIUM IN  
SODIUM TUNGSTEN BRONZE. John F. Smith, G. C.  
Danielson, and H. A. Wilhelm. Mar. 1953. 51p. Contract  
W-7405-eng-82. (ISC-341)
- KAPL-982 1079  
Knolls Atomic Power Lab.  
CORROSION OF ZIRCONIUM AND ITS ALLOYS IN LIQUID

METALS. R. F. Koenig. Oct. 1, 1953. 14p. Contract  
W-31-109-eng-52. (KAPL-982)

NYO-3648 1076  
Massachusetts Inst. of Tech.  
THE MEASUREMENT OF THERMAL CONDUCTIVITY OF  
REFRACTORY MATERIALS. PROGRESS REPORT. F. H.  
Norton, W. D. Kingery, et al. Oct. 1, 1953. 9p. Contract  
AT(30-1)-960. (NYO-3648)

NYO-3647 1075  
Massachusetts Inst. of Tech.  
THE MEASUREMENT OF THERMAL CONDUCTIVITY OF  
REFRACTORY MATERIALS. THERMAL CONDUCTIVITY.  
PART 8. A THEORY OF THERMAL CONDUCTIVITY OF  
POROUS MATERIALS. Arthur L. Loeb. 16p. PART 9.  
EXPERIMENTAL INVESTIGATION OF THE EFFECT OF  
POROSITY ON THERMAL CONDUCTIVITY. J. Franci and  
W. D. Kingery. 18p. PART 10. DATA FOR SEVERAL  
PURE OXIDE MATERIALS CORRECTED TO ZERO  
POROSITY. W. D. Kingery, J. Franci, R. L. Coble, and  
T. Vasilos. 8p. F. H. Norton, director. Sept. 30, 1953.  
62p. Contract AT(30-1)-960. (NYO-3647)



An asterisk preceding the abstract number indicates that the corresponding report is included in the "Selected Subjects of Interest to Industry" section of this issue.

## GENERAL

968

**A GLOSSARY OF TERMS IN NUCLEAR SCIENCE AND TECHNOLOGY.** National Research Council Conference on Glossary of Terms in Nuclear Science and Technology. New York, American Society of Mechanical Engineers, 1953. 278p.

This glossary is the result of a coördinated effort, by a committee of the National Research Council, to collate the activities of several societies and organizations that had been independently compiling glossaries of terms in the various specialized fields related to nuclear science. The terms included in this edition are the result of critical evaluations based upon an earlier publication of individual sections. These sections have been retained in this edition and are published under the titles of Physics, Reactor Theory, Reactor Engineering, Chemistry, Chemical Engineering, Biophysics and Radiobiology, Instrumentation, Isotopes Separation, and Metallurgy. In general, the inclusion of terms in each section has been limited by emphasizing those peculiar to the field of nuclear energy, those used in a different sense or emphasis than that which is commonly understood in other connections, and those used so infrequently as to be unfamiliar. These criteria have been modified in cases where particular terms are included as useful and ready information for the reader who is unfamiliar with material outside his special interest. Extensive cross references have been inserted where old terms have become obsolete in the light of new data or when several names are in common usage for the same item. Examples of this are provided by references to  $\rho$  mesons and Wigner nuclides. Considerable effort has been made to include terms of current interest, as far as security limitations will permit. In this connection, numerous tables and graphs have been included which summarize such information as the decay schemes of several heavy and transuranic elements, the properties and disintegration modes of the known mesons, and the DuMond-Cohen values for the important physical constants. For convenience in referring to terms that have application in more than one section of the glossary, an alphabetical index of terms is also provided. The terms, as defined in this glossary, have been submitted to the American Standards Association for designation as proposed American Standards. (K.S.)

969

**ANNUAL REVIEW OF NUCLEAR SCIENCE.** Vol. 3. Stanford, Annual Reviews, Inc., 1953. 412p.

Chapters on the interaction of nuclear radiations with chemical and biological materials and systems have been added to the more or less standard topics such as nuclear reactions, structure, and instrumentation. With such a broad concept it is not possible to cover the entire range of topics, and the reader is thus encouraged to evaluate Annual

Review of Nuclear Science in terms of an integration over two or three years. The volume consists of 15 chapters, each of which contains an extensive bibliography. Separate abstracts have been prepared for the individual chapters. (L.M.T.)

## BIOLOGY AND MEDICINE

970

Los Alamos Scientific Lab.  
**SEDIMENTATION AND VISCOSITY STUDIES ON THE CAPSULAR AND SOMATIC POLYSACCHARIDES OF PNEUMOCOCCUS TYPE III.** Virgil L. Koenig and J. D. Perrings. [1953] 12p. Contract W-7405-eng-36. (AECU-2768)

971

Radiation Lab., Univ. of Calif., Berkeley  
**THE EFFECT OF THYROID EXTRACT ON SERUM LIPOPROTEINS AND SERUM CHOLESTEROL.** Beverly Strisower, John W. Gofman, Elmer F. Galioni, Albert A. Almada, and Alexander Simon. Oct. 22, 1953. 39p. Contract W-7405-eng-48. (UCRL-2374)

The administration of thyroid extract in doses of 10 grains daily resulted uniformly in significant lowering of serum cholesterol, Standard  $S_{f0-12}$  lipoproteins, and Standard  $S_{f12-20}$  lipoproteins in nineteen schizophrenic patients. Lowering of serum cholesterol and Standard  $S_{f0-12}$  lipoproteins was observed in all of four normals given 3 grains of thyroid daily. Responses were of borderline significance in the lipoproteins of the Standard  $S_{f20-400}$  band. Protein-bound I determinations were above 4  $\mu\text{g } \%$  in all cases studied, so that for this criterion, at least, thyroid hypofunction was not present in any of the subjects. The lipoprotein and cholesterol lowering was accompanied by a state of negative caloric balance in these experiments. The magnitude of the drop in serum cholesterol or Standard  $S_{f0-20}$  lipoproteins was positively correlated with the initial levels of both measures. The question is raised as to whether this suggests that inadequate thyroid function, at least with respect to lipid metabolism, is present in individuals with elevated lipoprotein and cholesterol values, where other overt causes for the elevation are absent. (auth)

972

Atomic Energy Project, Univ. of Rochester  
**SELECTED STUDIES ON THE ROLE OF BONE PHOSPHATASE IN CALCIFICATION.** Victor DiStefano. Sept. 17, 1953. 98p. Contract W-7401-eng-49. (UR-272)

A theory of bone calcification is presented in which the role of phosphatase is limited to the formation of collagen fiber template. It is suggested that the process of mineral deposition is one of crystallization whereby Ca and P are



deposited upon a preformed organic surface. It is suggested that the deposition of Ca upon this surface could be accomplished by the existence of phosphate groups. It is assumed that hydroxy amino acids exist in collagen as amino acid phosphates arranged in the spatial configuration of the bone salt lattice, forming a basic template on which alternately Ca and then P are deposited to form the bone salt. Experimental evidence is presented to substantiate this theory. (C.H.)

#### RADIATION EFFECTS

973

Delaware Univ.

RESEARCH PERTAINING TO X-RADIATION DAMAGE IN THE PARASITIC WASP, *HABROBRACON*. FINAL REPORT FOR THE PERIOD JULY 1, 1950 TO AUGUST 31, 1953. Arnold M. Clark. Nov. 30, 1953. 29p. Contract AT(30-1)-953. (AECU-2764)

Results are reported in an investigation of the relationship between chromosome number and radiosensitivity in the parasitic wasp, *Habrobracon*. In this species haploid males, diploid males, and diploid females occur normally. Data on the differential radiosensitivity of the cleavage stage of the embryo, larval stage, and pupal stage indicate that the differential radiosensitivity between haploids and diploids is dependent upon the stage of development at which the organisms were irradiated and cannot be correlated with gene number. No direct correlation was found between the radiosensitivity pattern and O consumption, phosphatase activity, nucleic acid changes, and catalase activity. (C.H.)

\*974

Argonne National Lab.

ANNOTATED BIBLIOGRAPHY IN RADIOBIOLOGY. Sophie V. Stephens, Argonne National Lab. and Robert D. Boche, Air Force Radiation Lab., Univ. of Chicago, comps. [1953] 367p. (ANL-5111)

This bibliography contains 2153 abstracts covering all phases of the biological effects of radiation. Abstracts are arranged in sections covering general information, effects of external radiation, effects of internal radiation and metabolism and toxicology of internally deposited radioelements, radiation sickness, mechanisms of radiation effects, and effects of radiation on growth and development, genetics, and cytology. (C.H.)

975

Hanford Works

INHIBITION OF GROWTH OF *CHLORELLA PYRENOIDOSA* BY BETA-EMITTING RADIOISOTOPES. J. W. Porter and H. J. Knauss. Oct. 19, 1953. 17p. Contract W-31-109-eng-52. (HW-29666)

*Chlorella pyrenoidosa* cells were grown for 3 days in the presence of several levels of  $H_2O$ ,  $P^{32}$ ,  $Sr^{90}$ ,  $Y^{90}$ , and  $S^{35}$  and then subcultured for 3 days in nonradioactive inorganic nutrient solution. Growth rates of cells were decreased in proportion to the dose of radiation received above levels of approximately 1000 rep/day. The reduced rate of growth continued in subculture with time (for the 3-day period) as a function of the dose received. An increase in the average cell size also occurred during the growth of the algae in the radioactive solutions. The results reported do not allow a deduction of the specific site of action of the ionizing radiations on the algae. However, several possible modes of action consistent with the reported results are discussed. (auth)

976

Atomic Bomb Casualty Commission

THE GROWTH AND DEVELOPMENT PROGRAM OF THE ATOMIC BOMB CASUALTY COMMISSION. ANALYSIS OF OBSERVATIONS ON MATURATION, BODY BUILD AND

POSTURE TAKEN IN 1951 ON 4,800 HIROSHIMA CHILDREN. Earle L. Reynolds. Oct. 30, 1952. 69p. (NYO-4459)

977

Atomic Energy Project, Univ. of Rochester

QUARTERLY TECHNICAL REPORT [FOR] JULY 1 THRU SEPTEMBER 30, 1953. Nov. 10, 1953. 47p. Contract W-7401-eng-49. (UR-290)

Severe neurological dysfunction and multiple subarachnoid hemorrhage are described which were observed in a dog following exposure to 550 r x radiation. Factors affecting the preparation of tissue samples from the carcasses of large animals prior to the radiometric determination of Po are discussed. Preliminary experiments to determine the effect of Piromen on the phagocytosis-promoting effect on leukocytes showed that the addition of Piromen to a mixture of heparinized whole blood and saccharated Fe did not increase the uptake of the Fe by human or dog leukocytes. Further evidence is presented for the in vivo incorporation of  $\alpha$ - $C^{14}$ -acetate into the stroma of erythrocytes. An application of the findings to studies of defects in erythrocyte stroma in pernicious anemia is described. (C.H.)

978

VERTEBRATE RADIOBIOLOGY: EMBRYOLOGY. Roberts Rugh. *Ann. Rev. Nuclear Sci.* 3, 271-302(1953).

The results of the better controlled experiments of the last several years concerning studies of radiation effects on embryos are summarized. Practically all of the studies reviewed dealt with the highly penetrating x or  $\gamma$  rays, since thus far the embryo has not been used as a test object for determining any biologically qualitative differences between radiations. Studies which indicate gradients in development, or those which tend to alter the embryonic course of the development, are included. Also included are factors affecting the gamete, which alter the subsequent embryonic development. Separate groupings of the studies are made in chronological order, starting with fish and including amphibia, chick, and mammal. Summary statements appearing to be justified are made in a list of general conclusions. 73 references. (L.M.T.)

979

VERTEBRATE RADIOBIOLOGY: HISTOPATHOLOGY AND CARCINOGENESIS. J. Furth and A. C. Upton. *Ann. Rev. Nuclear Sci.* 3, 303-38(1953).

This survey of recent literature discloses a trend to correlate radiation sensitivity with nucleic acid synthesis and enzyme activity. With respect to early injury there is remarkable similarity in the behavior of different species. Carcinogenic response, on the other hand, varies so widely with species and strains that the liability of man to develop certain neoplasms will be learned probably only from observations on man. On closer survey, a sharp difference is noted between neoplasms that are due to a local action (e.g., of skin and bone) and those that are dependent, in part at least, on an indirect mechanism (e.g., of ovary and other endocrine organs, and possibly leukemia). All species appear to be susceptible to the former which future research may relate more quantitatively to ionization events. The latter neoplasms may be related to species differences in the function or responsiveness and interrelation of different organs. 204 references. (auth)

980

CELLULAR RADIOBIOLOGY. Arnold H. Sparrow and Frederick Forro, Jr. *Ann. Rev. Nuclear Sci.* 3, 339-68 (1953).

This review is concerned with work that has been done toward determining a complete picture of radiation effects on cells, i.e., correlating the primary physical events and chemical processes that are possible in matter, following



irradiation, with alterations in observable cellular properties. Most of the topics reviewed come from the two general methods of attack: (1) study of cellular molecules or structures in vitro and from knowledge gained to synthesize a picture of the processes in vivo and (2) observation of the effect of irradiating cells in vivo as a function of modifying conditions so as to infer the intermediate processes. 279 references. (L.M.T.)

981

PRACTICAL ASPECTS OF RADIATION INJURY. Louis H. Hempelmann and Joseph G. Hoffman. *Ann. Rev. Nuclear Sci.* 3, 369-92(1953).

Some of the manifold reactions of the human body to ionizing radiations are described. Beginning with high doses, the first part of the paper deals with the description of acute radiation injury in man. Following this a brief appraisal is made of the possible lines of therapeutic alleviation which are suggested by current animal experimentation. The last part of the paper affords a transition from high to subacute doses and describes late tissue reactions which arise at various dosage levels. 69 references. (auth)

982

SOME OBSERVATIONS ON THE RELATION DOSE MEASURES AND BLOOD CHANGES. Matts Helde and T. Wahlberg. *Acta Radiol.* 40, 435-42(1953). Oct.

The relationship between the frequency of the blood picture changes of certain types and the irradiation received during various periods of time was investigated. Observations over short periods of time show a considerably better correlation than the dosage per week. (auth)

983

HISTOLOGIC LESIONS IN THE THYROID GLANDS OF PATIENTS RECEIVING RADIOIODINE FOR HYPERTHYROIDISM. Morris E. Dailey, Stuart Lindsay, and Earl R. Miller. *J. Clin. Endocrinol. and Metabolism* 13, 1513-29 (1953). Dec.

A variety of lesions are described which were observed upon histologic examination of the thyroid glands from 23 patients who had received  $I^{131}$  for diagnosis or treatment of hyperthyroidism. The pathogenesis of the lesions is discussed. (C.H.)

984

LACK OF PROTECTIVE EFFECT OF ALLYL THIOUREA AGAINST X-IRRADIATION. Robert N. Feinstein and Gladys J. Cotter. *Science* 118, 552(1953). Nov. 6.

Alexander and Fox (*Nature* 170, 1022(1952)) found a correlation between the ability of various agents to protect animals against x rays and the ability of these agents to protect polymethacrylic acid from radiation-induced loss of viscosity. Their most effective agent was allyl thiourea, and they pointed out that this system had never been tested biologically. Results of an experiment are presented in this note in which it was determined that allyl thiourea has no protective effect whatsoever. It therefore appears that the polymer system of Alexander and Fox may not be used as an in vitro test of in vivo protective action. (L.M.T.)

985

THE EFFECT OF EXPOSURE TO THE ATOMIC BOMBS ON PREGNANCY TERMINATION IN HIROSHIMA AND NAGASAKI: PRELIMINARY REPORT. J. V. Neel, W. J. Schull, D. J. McDonald, N. E. Morton, M. Kodani, K. Takeshima, R. C. Anderson, J. Wood, R. Brewer, S. Wright, J. Yamazaki, M. Suzuki, and S. Kitamura. *Science* 118, 537-41(1953). Nov. 6.

Preliminary results are presented from an analysis of pregnancy terminations in Hiroshima and Nagasaki over the past seven years in an effort to correlate these with the delayed effects of exposure to the atomic bombs. Each parent was grouped into one of 5 radiation categories so

that the average amounts of whole-body radiation, both neutron and  $\gamma$ , could be estimated. Newborn children were examined as quickly as possible in the case of an abnormal termination, and on a more leisurely schedule if reported normal. Autopsies were performed on as many children who were stillborn or who died during the neonatal period as possible. About one-third of the children examined at birth were reexamined at age nine months. It is pointed out that, although the results given are incomplete, the findings are entirely consistent with what is known of the radiation genetics of a wide variety of plant and animal material. (L.M.T.)

986

STUDIES OF THORIUM X APPLIED TO HUMAN SKIN. III. THE RELATIVE EFFECTS OF ALPHA AND BETA-GAMMA IRRADIATION IN THE PRODUCTION OF ERYTHEMA. Victor H. Witten, Earle W. Brauer, Vera Holmstrom, and Robert Loevinger. *J. Invest. Dermatol.* 21, 249-57(1953). Oct. (cf. NSA 5-4999 and 6-4711).

An evaluation was made of the relative biological effectiveness of the  $\alpha$  and the  $\beta$ - $\gamma$  components of radiation from ThX ( $Ra^{224}$ ) in the production of erythema of the human skin. Two types of thin-window plaques were designed which allowed transmittal to the skin of the  $\alpha$  and of the  $\beta$ - $\gamma$  radiation without allowing the ThX solution to penetrate the skin. The degree of erythema produced by application of the plaques containing ThX was found to be small in contrast to the intense erythema produced by the direct application of an equal amount of alcoholic solution of ThX to an equal area of skin. The relative biologic effectiveness of the  $\alpha$  component was found to be many times greater than that of the  $\beta$ - $\gamma$  components as judged by the degree of erythema and pigmentation produced. (C.H.)

#### RADIATION HAZARDS AND PROTECTION

987

Brookhaven National Lab.

MECHANICAL SHOE SANDER. Jere C. Austin. [1953?]. 5p. (BNL-1614)

A practical and efficient method is described of adapting an ordinary belt sanding machine for decontaminating shoes. The use of this equipment can result in a general increase in efficiency by cutting down on time consumed by personnel in decontaminating footwear. (J.E.D.)

988

RADIATION DOSIMETRY AND PROTECTION. Leonidas D. Marinelli. *Ann. Rev. Nuclear Sci.* 3, 249-70(1953).

Radiation dosage determinations usually involve measurements of gas ionization in cavity chambers and can be represented by the equation  $D_m = J_m W \rho_m$ , where  $D_m$  is the dose in the walls of the cavity in ergs/g,  $J_m$  is the number of ion pairs per unit mass of gas in the cavity,  $W$  is the energy in ergs necessary to form a pair of ions in the gas, and  $\rho_m$  the ratio of the mass stopping power of the wall material to that of the gas for the ionizing particles associated with the incident radiation. This review is concerned with recent evidence related to the usefulness of the above equation in the dose measurement of photons and neutrons of widely different energies, with special emphasis on comparisons with calorimetric measurements when available. 140 references. (L.M.T.)

989

PREVENTIVE AND THERAPEUTIC EFFECTS OF CERTAIN CHEMICAL SUBSTANCES AGAINST RADIATION. André Herne. *Bruxellas-med.* 33, 2267-77(1953). Nov. 8. (In French)

The physical and chemical effects of radiation are discussed. The efficacies of several substances in reducing these effects are reviewed. It is concluded that cystein-



amine offers the most protection and is the least toxic. 23 references. (J.S.R.)

## TOXICOLOGY STUDIES

\*990

Atomic Energy Project, Univ. of Rochester  
A COMPARATIVE STUDY OF THE INHIBITORY ACTIONS OF MERCURY AND URANIUM ON YEAST AND YEAST HEXOKINASE. Leon Hurwitz. Oct. 22, 1953. 100p. Contract W-7401-eng-49. (UR-252)

Data are presented from a study of the manner in which U and Hg inhibit glucose metabolism in whole yeast and on the role of enzyme systems in the metabolic inhibitions. Data are included on the kinetics and method of U and Hg inhibition of purified yeast hexokinase. (C.H.)

991

Atomic Energy Project, Univ. of Rochester  
THE METABOLIC FATE OF SYNTHETIC METAPHOSPHATES AND THEIR INFLUENCE ON URANIUM EXCRETION. Robert Megirian. Sept. 17, 1953. 65p. Contract W-7405-eng-49. (UR-281)

Various polyphosphates were injected into rats simultaneously with sublethal amounts of uranyl nitrate given intraperitoneally. The cyclic polymers enhanced the excretion of U whereas the linear polymers depressed the excretion when given by the same route of administration as the uranyl nitrate. Evidence is presented to show that the polyphosphates are able to affect the excretion of U only during the first 24-hr period after the injection of the heavy metal. (auth)

992

FLUCTUATIONS OF BREATH RADON IN SUBJECTS SEATED AT REST. E. J. Martin and J. K. W. Ferguson. Arch. Ind. Hyg. and Occupational Med. 8, 574-81(1953). Dec.

The Rn content of exhaled breath of subjects with abnormally high but stabilized Rn burdens was measured with the subjects seated at rest. Results are reported as curies/liter of expired air and as curies/min. Methods of sampling and of computing curies/min are described. (C.H.)

993

ACUTE INHALATION TOXICITY OF BERYLLIUM. IV. BERYLLIUM FLUORIDE AT EXPOSURE CONCENTRATIONS OF ONE AND TEN MILLIGRAMS PER CUBIC METER. Herbert E. Stokinger, Charles J. Spiegl, Robert E. Root, Robert H. Hall, Luville T. Steadman, Catherine A. Stroud, James K. Scott, Frank A. Smith, and Dwight E. Gardner. Arch. Ind. Hyg. and Occupational Med. 8, 493-506(1953). Dec.

Pulmonary lesions were produced in animals exposed to BeF<sub>2</sub> mist at concentrations of 10 and 1 mg/m<sup>3</sup>. These resembled the lung changes resulting from inhalation of BeSO<sub>4</sub>, but BeF<sub>2</sub> was found to be acutely more toxic than BeSO<sub>4</sub>. Hematological changes suggestive of the progressive development of macrocytic anemia were observed following exposure to 1 mg BeF<sub>2</sub>/m<sup>3</sup>. Data are included on the tissue distribution of Be following inhalation of BeF<sub>2</sub>. In relation to quantity of Be in the lungs, a considerably greater proportion was distributed to the skeleton, liver, spleen, and kidneys after inhalation of BeF<sub>2</sub> than was found in previous studies of the insoluble BeO or the soluble and readily dissociated BeSO<sub>4</sub> mist. Urinary uric acid excretion was found to offer promise as an index of the degree of exposure to Be. (C.H.)

## TRACER APPLICATIONS

\*994

Los Alamos Scientific Lab.  
THE METABOLISM OF C<sup>14</sup> LABELED ETHYLENEDIAMINE-TETRAACETIC ACID IN HUMAN BEINGS. Harry Foreman

and Theodore T. Trujillo. [1953]. 13p. Contract W-7405-eng-36. (AECU-2775)

This study in humans using C<sup>14</sup>-labeled material indicated that (ethylenediamine)tetraacetic acid passes through the body unchanged. It is excreted via the kidney by both glomerular filtration and tubular excretion. The turnover time from the blood is approximately 1 hr after intravenous administration and 1.5 hr after intramuscular injection. It quickly mixes with almost all of the body water, except that it does not pass into the red cells and passes relatively slow into the spinal fluid compartment. It is poorly absorbed from the gastrointestinal tract and practically not at all through the skin. The use in therapeutic doses did not bring about any unusual cardiovascular changes in the cases studied. (auth)

995

Brookhaven National Lab.  
THE EXCRETION AND RETENTION OF THE CARBON OF INGESTED SUCROSE BY THE MOUSE. Robert Steele. [1953] 29p. (BNL-1222(rev.))

Data are presented on the retention and excretion of the C of uniformly C<sup>14</sup>-tagged sucrose after ingestion by male C-57 black mice. The anatomic distribution of retained C<sup>14</sup> among 29 tissues of the mouse was studied and is reported for the period from 3.5 hr to 36 days following C<sup>14</sup>-sucrose ingestion. The distribution of C<sup>14</sup> in several lipid fractions of liver and small intestine is also reported. (auth)

996

Hanford Works  
THE UPTAKE AND TRANSLOCATION OF YTTRIUM BY HIGHER PLANTS. J. H. Rediske and A. A. Selders. Aug. 21, 1953. 17p. Contract W-31-109-eng-52. (HW-29091)

Plants were grown in nutrient solutions to determine the effect of some of the factors important in the uptake of Y using Y<sup>91</sup> as a tracer. It was found that in general the uptake was proportional to the amount of Y added to the solution; however, the uptake efficiency did tend to increase at added concentrations above 1 ppm. Within the range of pH 5 to 7 the uptake efficiency was proportional to the hydrogen-ion concentration. Tomato exhibited the greatest uptake efficiency for Y with a leaf: root ratio of  $2 \times 10^{-3}$ . Red kidney bean was next with  $6 \times 10^{-4}$  and Russian thistle and wheat followed with  $6 \times 10^{-5}$  and  $3 \times 10^{-5}$ , respectively. Further data indicate that comparatively the uptake of Y is low as exemplified by the bean plant with the primary leaves attaining the greatest concentration. There was little retranslocation from the aerial tissues, and little loss occurred from the massive accumulations on the roots even when the plants were changed to solutions in which Y was absent. Neubauer experiments indicate a concentration factor

$$\left( \frac{\text{conc. aerial tissues}}{\text{conc. in soil}} \right) \text{ of } 0.006 \text{ on a dry weight basis for barley from an Ephrata fine sandy loam soil. (auth)}$$

997

Radiation Lab., Univ. of Calif., Berkeley  
THE EFFECT OF AGE AND LOW PHOSPHORUS RICKETS ON THE METABOLISM OF CALCIUM<sup>45</sup> IN RATS (thesis). Duncan MacLaren Thomson. Aug. 1953. 130p. Contract W-7405-eng-48. (UCRL-2302)

Tracer techniques, employing Ca<sup>45</sup>, were applied to a comparison of Ca metabolism in adult, young, and rachitic rats, particularly with respect to the skeletal uptake and urinary and fecal excretion of Ca and the effects of increased or decreased Ca or P supply on Ca metabolism. Data are presented in tabular form. (C.H.)

998

DISTRIBUTION OF COLLOIDAL RADIOACTIVE CHROMIC PHOSPHATE AFTER INTRACAVITARY ADMINISTRATION IN THE RAT. John A. D. Cooper and Elinor M. Zorn. J.



Lab. Clin. Med. 42, 867-71(1953). Dec.

The distribution and excretion of various preparations of radioactive colloidal chromic phosphate after intracavitary administration in the rat have been studied. Colloid with particle sizes of  $0.2 \mu$  was found in large amounts in the liver after intrapleural and intraperitoneal administration. With larger particle size a smaller fraction appeared in the liver. Urinary excretion was negligible in all animals studied. (auth)

## CHEMISTRY

999

Laboratory for Nuclear Science, Mass. Inst. of Tech. CHEMISTRY OF THE FISSION ELEMENTS GROUP; NUCLEAR CHEMISTRY (INORGANIC) GROUP; AND NUCLEAR CHEMISTRY (ORGANIC) GROUP. p.1-28 of PROGRESS REPORT NO. 30 [FOR] MAY 31, 1953 TO AUGUST 31, 1953. Aug. 31, 1953. 28p. Contract AT(30-1)-905. (AECU-2740(p.1-28))

Initial investigations of high-sensitivity coulometry for the determination of As and heavy elements are reported, together with polarographic reduction techniques for the analysis of In. Average pulse-height data are accumulated for various inorganic liquid scintillators containing organic additives. Results of experimentation on the solvent extraction of Ga(III) from HCl are presented as a function of HCl concentration. The relative yields of photospallation nuclides from 140- and 320-Mev bombardment of As are tabulated, together with evidence of photofission in middle-weight nuclei bombarded by 320-Mev x rays. Fission yields of some species in the 15-Mev deuteron fission and 13-Mev bremsstrahlung fission of  $U^{235}$  have been determined. Additional data on 15-Mev deuteron fission of  $U^{235}$  and natural U are also included. Studies on the isotope-position rearrangements in the diazotization of exo- and endo-norbornylamine-3- $C^{14}$  have been completed, and the results are discussed, together with the mechanisms involved in the amination of aryl halides, the halide exchange of TCl in benzene solution, and the reaction kinetics of TCl with azide in benzene at  $50^\circ C$ , where T is the trityl group. (K.S.)

1000

New York Univ.

THE RATE OF DISSOLUTION OF ZINC IN CHROMIC CHLORIDE SOLUTIONS. Cecil V. King and Natalie Mayer. Jan. 15, 1953. 29p. Contract AT(30-1)-816. (NYO-3463)

The relative potentials of the Zn-Zn ion,  $Cr^{+2}-Cr^{+3}$  ion systems might lead one to expect smooth progress of the reaction  $Zn + 2Cr^{+2} \rightarrow Zn^{+2} + 2Cr^{+3}$ . However, various other reactions are possible and the dissolution or corrosion process is complicated; it is electrochemical in nature and in some solutions rapid enough to permit transport control of the rates. The dissolution rate is highly dependent on the form of  $Cr^{+3}$  ion present, on pre-treatment of the metal surface, in some solutions on the acidity, and under some conditions the main reaction is  $H_2$  evolution with little reduction or  $Cr^{+3}$  ion. (auth)

1001

Yale Univ.

THE DIFFERENTIAL DIFFUSION COEFFICIENTS OF MAGNESIUM AND BARIUM CHLORIDES IN DILUTE AQUEOUS SOLUTIONS AT  $25^\circ$ . Herbert S. Harned and Francesco M. Polestra. Dec. 10, 1953. 7p. Contract AT(30-1)-1375. (NYO-6398)

The differential diffusion coefficients of  $MgCl_2$  and  $BaCl_2$  between 0.0005 and 0.006M at  $25^\circ$  in water have been determined by the conductometric method. In accord with similar results for  $SrCl_2$ , the values of these diffusion coefficients agree well with those predicted by the equations of the Nernst-Onsager and Fuoss theory. (auth)

1002

Radiation Lab., Univ. of Calif., Berkeley  
CHEMISTRY DIVISION QUARTERLY REPORT, JUNE, JULY, AND AUGUST 1953. Sept. 30, 1953. 96p. Contract W-7405-eng-48. (UCRL-2355)

Progress is reported on the following investigations: the  $\gamma$  spectrum of AcK; the  $\gamma$  spectrum and conversion electron spectrum of  $Am^{241}$ ; half lives and  $\gamma$  emission of neutron-deficient isotopes of Ir, Pt, Au, and Hg; absorption spectrum of  $CmF_3$  and  $GdF_3$ ; vapor pressure of  $AmF_3$ ;  $\alpha$ - $\gamma$  coincidence pulse-height analysis of  $Np^{237}$ ; development of an analog computer for plotting the growth and decay of a radioactive disintegration chain; design of a portable indicating  $\gamma$  meter; an intracyclotron  $\alpha$ -ray spectrometer; construction of a bombardment ion source for a mass spectrometer; cyclic regeneration of  $CO_2$  acceptor in photosynthesis; mechanism of quantum conversion in photosynthesis; isolation of per-seitol and mannoheptulose; metabolism of fatty acids by pantothenic acid-deficient rats; investigation of metabolism of polyglycol 33-3 in mice; preparation of diethyl malonate-2- $C^{14}$ ; studies on adenine metabolism;  $\Delta^7$ -cholesterol content of rabbit serum; effect of x irradiation of mice on the liver concentration of a number of coenzymes; complexing of Sc by fluoride ion; thermodynamic properties of  $S_2O_5^{2-}$ ; and spectrophotometric studies. (For preceding period see UCRL-2257.) (J.S.R.)

1003

Radiation Lab., Univ. of Calif., Berkeley  
INTERACTION OF HEPARIN ACTIVE FACTOR AND EGG-YOLK LIPOPROTEIN. A. V. Nichols, L. Rubin, and F. T. Lindgren. Oct. 1953. 18p. Contract W-7405-eng-48. (UCRL-2381)

Results are reported from an in vitro study of reactions taking place during incubation of a lipemic serum from egg yolk with in vivo heparinized plasma. Data are presented on the interaction of active principle in heparinized plasma with lipoprotein, and possible mechanisms of action are suggested. (C.H.)

1004

REPORT TO THE TITANIUM COMMITTEE ON THE RESULTS OF ILMENITE CHLORINATION. Yu. F. Krieger [Kriger]. Translated from Contributions to the Study of the Natural Resources of the U.S.S.R., No. 56, Titanium and its Compounds 1, 23-33(1926). 5p. (AEC-tr-704)

It was found possible to prepare  $TiCl_4$  by direct chlorination of elements by means of a furnace which enables simultaneous heating and drying of the briquets as well as chlorination and which saves fuel and labor costs. (J.E.D.)

1005

ON THE DYNAMICS OF EVAPORATION OF IDEAL MULTI-COMPONENT LIQUID MIXTURES. L. I. Rubinshtein. Translated from Doklady Akad. Nauk S.S.S.R. 90, 987-90 (1953). 3p. (NSF-tr-129)

The 3-dimensional case of evaporation of ideal multi-component liquid mixtures was studied. It is assumed that vapor propagation in an open atmosphere takes place purely by diffusion without convection, that the uniformity of the liquid phase is preserved throughout the entire process, and that the thickness of the layer which evaporates is small in comparison with the linear dimensions of the evaporation surface. (J.A.G.)



1006

# ON THE DYNAMICS OF EVAPORATION OF POLYCOMPONENT SOLUTIONS IN A NONVOLATILE SOLVENT.

L. I. Rubinshtein. Translated from *Doklady Akad. Nauk S.S.S.R.* **91**, 767-9(1953). 3p. (NSF-tr-132)

The evaporation of a dilute polycomponent solution in a nonvolatile solvent is discussed, on the assumption that the nature of vapor transport in the open atmosphere is purely diffusional and without convection and that the uniform volume of distribution of the liquid phase is maintained throughout the process. Only the one-dimensional case is examined. (J.A.G.)

1007

# THE HALF-WAVE POTENTIAL OF LITHIUM. Walter E. Clark. *J. Am. Chem. Soc.* **75**, 6042(1953). Dec. 5.

An accurate determination of the half-wave potential of aqueous  $\text{Li}^+$  was made. It was found to be independent of concentration, Hg height, and capillary employed. The experimental value, corrected for cell resistance, was  $-2.331 \pm 0.003$  v vs. the standard calomel electrode. (J.S.R.)

1008

# ISOTOPE EFFECTS IN CHEMICAL REACTIONS. Peter E. Yankwich. *Ann. Rev. Nuclear Sci.* **3**, 235-48(1953).

Progress reported through the calendar year 1952 in investigations of the effect of isotopic substitution on the rates and equilibria of chemical reactions is reviewed. The discussions concern the isotopes of the following elements: H, C, N, O, S, and Hg. 79 references. (L.M.T.)

## ANALYTICAL PROCEDURES

1009

Los Alamos Scientific Lab.

# STUDIES ON SODIUM DESOXYRIBONUCLEATE FROM PNEUMOCOCCUS TYPE III. Virgil L. Koenig, Louise Larkins, and J. D. Perrings. [1953]. 15p. [Contract W-7405-Eng-36] (AECU-2772)

Desoxyribonucleic acid was isolated from a suspension of pneumococcus type III organisms lysed with Na desoxycholate in the presence of citrate, and saturated with NaCl. Ultra-centrifugal studies were carried out on the purified Na desoxyribonucleate, and results are presented in tabular form. The partial specific volume was found to be 0.515 at 20°C. (C.H.)

1010

# Worcester Foundation for Experimental Biology THE PRESENCE OF THREE 17-KETOSTEROIDS IN ADRENAL PERFUSATES. Eric Bloch, Ralph I. Dorfman, and Gregory Pincus. [1953] 17p. Contracts DA-49-007-MD-418 and AT(30-1)-918. (NYO-4564)

Bovine adrenal glands were perfused with blood containing added ACTH and the perfusates purified for study of their  $\text{C}_{19}$  steroid contents. Individual steroids present in the purified extracts were detected and characterized by studying the behavior of the free compounds and their derivatives by paper chromatographic techniques involving several solvent systems and color tests. By these methods, five 17-ketosteroids were found in adrenal perfusates, three of which exhibited properties identical to standard samples of  $\Delta^4$ -androstene-3,17-dione,  $\Delta^4$ -androstene-3,11,17-trione, and  $\Delta^4$ -androstene-11 $\beta$ -ol-3,17-dione. The conclusion is reached that the methods used here allow the identification of  $\Delta^4$ -androstene-3,17-dione,  $\Delta^4$ -androstene-3,11,17-trione, and  $\Delta^4$ -androstene-11 $\beta$ -ol-3,17-dione in adrenal perfusates with a high degree of certainty. (auth)

1011

# A NEW METHOD FOR THE MAGNETIC ANALYSIS OF OXYGEN. Karl F. Luft. Translated from *Z. angew. Phys.* **3**, 300-3(1951). 8p. (AEC-tr-1749)

A new method is described for the magnetic determination of  $\text{O}_2$ , based on the direct measurement of pressure effects which are produced by a modulated, nonhomogeneous magnetic field in a paramagnetic gas. With simple changes it can be used for the measurement of the difference in  $\text{O}_2$  content of two gases. It permits measurements of  $\text{O}_2$  contents with ranges of 0 to 1 and 0 to 100% within a few seconds and practically independent of the remaining properties of the gas mixture. (auth)

1012

# THE DETERMINATION OF DISSOLVED OXYGEN IN DEGASSED WATER. M. Delassus, R. Devaux, and P. Montigny. Translated by Margaret V. Colven from *Chaleur et ind.* **30**, 159-68(1949). 18p. (AEC-tr-1752)

The determination of dissolved  $\text{O}_2$  in degassed water was studied by potentiometric and colorimetric methods. It was found that both methods gave good results for extremely weak  $\text{O}_2$  concentration, of the order of 0.01 mg/l. (J.E.D.)

1013

# RESEARCHES ON POLAROGRAPHY IN ANALYTICAL CHEMISTRY. REPORT NO. 10. DETERMINATION OF SULFUR IN SULFUROUS IRON ORES AND IN THESE ORES AFTER ROASTING. M. Ishibashi, T. Fujinaga, and T. Ichikawa. Translated by E. R. Hope from *J. Chem. Soc. Japan* **73**, 263-5(1952). 8p. (AEC-tr-1753)

In the study of the determination of S in sulfide ores, the sulfate radical was precipitated as a Pb salt, and the Pb ion was determined by a polarographic method. Satisfactory results were obtained. (J.E.D.)

1014

# THORIUM—ITS ESTIMATION AND SEPARATION FROM CERITE EARTHS. N. Eswaranarayana. *Rec. trav. chim.* **72**, 1003-6(1953). Nov. (In English)

7-Hydroxycoumarin-4-acetic acid precipitates Th completely in the pH range 2.5 to 3.2. The precipitate is crystalline and may be filtered easily. Thorium in monazite is estimated after a single precipitation. As little as 1 mg of Th is accurately estimated. The metal is further separated from twice its amount of U in a single precipitation. Most of the common elements do not interfere. (auth)

1015

# POLAROGRAPHY OF ZIRCONIUM SALTS IN METHANOL. Eugene L. Colichman and Walter H. Ludwig. *Anal. Chem.* **25**, 1909-10(1953) Dec.

Well defined polarographic waves obtained for Zr salts in methanol were not complicated by the simultaneous appearance of  $\text{H}_2$  decomposition waves. Results for  $\text{Zr}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$  and  $\text{ZrOCl}_2 \cdot 8\text{H}_2\text{O}$  indicate the possible application of the polarographic method to the analysis of hydrated quadrivalent Zr salts. (J.S.R.)

1016

# EUROPIUM DETERMINATION IN RARE EARTH MIXTURES. David C. Foster and Howard E. Kremers. *Anal. Chem.* **25**, 1921-2(1953) Dec.

Eu can be determined in rare earth mixtures by passing the rare earth chloride solution through a Jones reductor into an excess of  $\text{FeCl}_3$ . An amount of  $\text{FeCl}_3$  equivalent to the amount of  $\text{EuCl}_2$  formed by reduction is reduced to  $\text{FeCl}_2$  and titrated with standard  $\text{K}_2\text{Cr}_2\text{O}_7$ . With samples containing 2 to 3%  $\text{Eu}_2\text{O}_3$ , analysis can be duplicated to within 1% precision; the accuracy is about 3 to 3.5% low. (J.S.R.)

1017

# ULTRAVIOLET SPECTROPHOTOMETRIC DETERMINATION OF NIOBIUM IN HYDROCHLORIC ACID. J. H. Kanzelmeyer and Harry Freund. *Anal. Chem.* **25**, 1807-9(1953) Dec.

The analytical methods available for the determination



of Nb are not well suited for routine analysis because of critical or time-consuming operations. A hitherto unreported absorption peak at 281 m $\mu$  serves as the basis for a spectrophotometric determination of Nb. In the absence of large amounts of Fe and certain other elements, the sample is obtained in a concentrated HCl solution and the absorbance measured at the specified wavelength. In the presence of interfering elements, the method may be used following a preliminary separation. It is rapid, accurate, and suitable for routine analysis. (auth)

1018

**COLORIMETRIC DETERMINATION OF VANADIUM(V) AND ITS SEPARATION FROM COPPER; USE OF CUPFERRON.** Hobart H. Willard, Ernest L. Martin, and Robert Feltham. *Anal. Chem.* 25, 1863-5(1953) Dec.

A new colorimetric method was developed based on the green color formed by V cupferrate in acetone. V was separated from Cu by precipitation with cupferron at a pH less than 1. This furnishes a good colorimetric method for V in the presence of Cu and a convenient separation from Cu. (auth)

1019

**DETERMINATION OF ELEMENTAL FLUORINE.** Irving Sheft, Herbert H. Hyman, and Joseph J. Katz. *Anal. Chem.* 25, 1877-9(1953) Dec.

In connection with an investigation of halogen fluorides, it appeared practical to adapt the Br-F reaction as an analytical method for F. Br, dissolved in BrF<sub>3</sub>, can be titrated with F gas at room temperature. The reaction is quantitative and the end point is readily detected by the discharge of the Br color. Using this procedure, the purity of several F samples has been determined to  $\pm 2\%$ . The uncertainty of the titration, which is limited by the error in reading the F pressure, should be reducible to about 0.1% by use of a more sensitive pressure-measuring device. It is possible to employ the titration to determine Br, or substances which yield Br on reaction with BrF<sub>3</sub>. These include metals, oxides, and halides other than fluorides. The titration can also be adapted for the determination of BrF<sub>3</sub>. (auth)

1020

**QUERCETIN AS COLORIMETRIC REAGENT FOR DETERMINATION OF ZIRCONIUM.** Frank S. Grimaldi and Charles E. White. *Anal. Chem.* 25, 1886-90(1953) Dec.

Methods described in the literature for the determination of Zr are generally designed for relatively large amounts of this element. A good procedure using colorimetric reagent for the determination of trace amounts is desirable. Quercetin has been found to yield a sensitive color reaction with Zr suitable for the determination of from 0.1 to 50  $\mu$ g of ZrO<sub>2</sub>. The procedure developed involves the separation of Zr from interfering elements by precipitation with p-dimethylaminoazophenylarsonic acid prior to its estimation with quercetin. The quercetin reaction is carried out in 0.5N HCl solution. Under the operating conditions it is indicated that quercetin forms a 2 to 1 complex with Zr; however, a 2 to 1 and a 1 to 1 complex can coexist under special conditions. Approximate values for the equilibrium constants of the complexes are  $K_1 = 0.33 \times 10^{-8}$  and  $K_2 = 1.3 \times 10^{-8}$ . Seven Bureau of Standards samples of glass sands and refractories were analyzed with excellent results. The method described should find considerable application in the analysis of minerals and other materials for macro as well as micro amounts of Zr. (auth)

1021

**TWO-DIMENSIONAL PAPER CHROMATOGRAPHY OF RADIOACTIVE SUBSTANCES.** F. P. W. Winteringham. *Nature* 172, 727-8(1953). Oct. 17.

A technique alternative to that of conventional two-dimensional paper chromatography is presented which utilizes the automatic scanning technique for unidimensional paper chromatograms (Winteringham et al., *Nucleonics* 10, No. 3, 52(1952)). After locating accurately the components separated in the first solvent without decomposing them, the problem then is to concentrate these components, or only those known to be further resolvable, by running with another solvent on to a second strip of paper so that it can be run in a second solvent under unidimensional conditions. A specific method is described for this. (L.M.T.)

1022

**POLAROGRAPHIC DETERMINATION OF MOLYBDENUM IN PRESENCE OF TUNGSTEN.** Louis Meites. *Anal. Chem.* 25, 1752-3(1953). Nov.

It was found that in a 1M Na citrate buffer of pH 7 Mo(VI) gives a wave possessing a small maximum but an excellently defined plateau, and that W(VI) neither precipitates nor gives an interfering reduction wave. Accordingly, the properties of the Mo wave were investigated, and a method for the determination of Mo in W compounds was developed. (J.A.G.)

1023

**DETERMINATION OF ZIRCONIUM IN ALUMINUM ALLOYS USING p-BROMO- OR p-CHLOROMANDELIC ACID.** Roland A. Papucci, Diane M. Fleishman, and Joseph J. Klingenberg. *Anal. Chem.* 25, 1758-60(1953). Nov.

Two procedures for the determination of Zr in Al alloys in the presence of Cu, Mg, Si, Fe, Mn, Ni, Sn, Sb, Cr, Ti, and V were developed. The first procedure is applicable to alloys containing less than 0.75% Si and involves direct precipitation of Zr with the mandelate reagents. Results indicated that Zr in Al alloys can rapidly and conveniently be determined gravimetrically by this method. The use of p-chloro- or p-bromomandelic acid is preferred to mandelic acid. No significant difference exists between the chloro and bromo derivatives. The second procedure is used for alloys containing more than 0.75% Si and involves a preliminary separation of Zr as the hydroxide. A procedure for the simultaneous determination of Si and Zr in the same sample is also described. (J.A.G.)

1024

**ANALYTICAL CHEMISTRY OF BERYLLIUM.** Frank A. Vinci. *Anal. Chem.* 25, 1580-5(1953). Nov.

The analytical chemistry of Be is reviewed. Beryllium may be detected by a quick spot test utilizing p-nitrobenzeneazoörcinol; other color and fluorescence methods are available. Methods of separation are dealt with. A frequently used gravimetric method for the quantitative determination of Be employs the separation of Be(OH)<sub>2</sub> and ignition to oxide. Precipitation of ammonium beryllium phosphate, ignition, and weighing as Be pyrophosphate are also utilized. An empirical titrimetric method depends upon converting Be(OH)<sub>2</sub> to weakly ionized BeF<sub>2</sub> with consequent release of an equivalent quantity of alkali. A photometric procedure is based upon a nearly specific colored lake formation with p-nitrobenzeneazoörcinol in the presence of a sequestering agent which acts to remove interferences. Analytical procedures employed in the determination of the impurities usually present in Be metal are tabulated. Methods used in the analysis of ores and alloys of Be are summarized. Possible toxicological effects and means of guarding against them are pointed out. (auth)

1025

**ANALYTICAL CHEMISTRY OF URANIUM.** Clement J. Rodden. *Anal. Chem.* 25, 1598-1601(1953). Nov.

Advances in the analytical chemistry of U from 1949 to the present are reviewed. In addition to papers on gravi-



metric, volumetric, colorimetric, fluorimetric, and radiochemical methods, x-ray absorption and coulometric procedures have been described for the first time. (auth)

1026

**SPECTROGRAPHIC DETERMINATION OF IMPURITIES IN ZIRCONIUM AND HAFNIUM.** Neil E. Gordon, Jr. and Ralph M. Jacobs. *Anal. Chem.* **25**, 1605-8(1953). Nov.

Recent developments in the production of Zr and Hf have made it necessary to develop methods for determining a large number of trace elements in these materials. This report presents a spectrochemical method for the determination of 22 elements found in Zr and Hf metals and oxides. Filings of the metal, or pulverized oxides, are loaded into cratered graphite electrodes. The sample is then volatilized in either an a-c or a d-c arc, depending on elements of interest, and the resulting spectra are photographed and evaluated by conventional techniques. Some of the standards were obtained from the Mass. Inst. of Tech. and the New Brunswick Laboratories of the AEC; others were synthesized from pure oxides of the base material and analytical grade reagents. Ten parts per million of most of the impurities can be determined with an accuracy of  $\pm 30\%$ . (auth)

1027

**DIRECT DETERMINATION OF OXYGEN IN LESS FAMILIAR METAL OXIDES.** Henry R. Hoekstra and Joseph J. Katz. *Anal. Chem.* **25**, 1608-12(1953). Nov.

A procedure for the quantitative determination of  $O_2$  in a number of metal and metalloid oxides has been developed. The method has also been used in the analysis of some oxide solid solutions, mixed oxide phases, ternary oxides, and oxygenated anions, and to determine combined  $O_2$  impurities in some metal salts. The  $O_2$  content of oxide samples (25 to 100 mg) can be determined with an accuracy of 0.4%. The reagent used,  $BrF_3$ , liberates molecular O at  $75^\circ C$  from oxides of all metals which form volatile fluorides or fluorides soluble in  $BrF_3$ . (auth)

1028

**QUANTITATIVE DETERMINATION OF OXYGEN IN GASES.** Leonard P. Pepkowitz and Edwin L. Shirley. *Anal. Chem.* **25**, 1718-20(1953). Nov.

Because of the extreme requirements in regard to the  $O_2$  content of the inert gas blankets required in connection with recent developments in technology of liquid-metal coolants, it is necessary to have an accurate and sensitive method applicable to the range below 100 ppm of  $O_2$ . The method described is based on the Winkler  $Mn(OH)_2$  reaction. The method is absolute with a zero blank. The standard deviation for precision is  $-0.77$  ppm of  $O_2$  and the sensitivity is 0.5 ppm. Relatively small samples can be handled, because the reactions can take place below atmospheric pressure. This fact eliminates the need for a carrier gas, thus removing one of the major sources of error. The apparatus is constructed of readily available laboratory equipment and can be made portable. Six to eight samples can be handled during the working day. (auth)

1029

**POLAROGRAPHIC DETERMINATION OF ALUMINUM IN TITANIUM ALLOYS.** James J. Mikula and Maurice Codell. *Anal. Chim. Acta* **9**, 467-75(1953) Nov. (In English)

Considerable interest has been shown in Ti metal because of its combination of desirable properties, including its favorable strength to weight ratio and its resistance to corrosion. Since Ti-Al alloys are fairly common, there is need for an accurate method of determining Al over a wide range of concentrations. This paper describes an accurate and fairly rapid polarographic method for determining Al based on the reduction of an Al-azo dye complex after removing Ti and other interferences by cupferron precipitation,

followed by electrolysis at a Hg cathode when necessary. The reduction takes place at  $-0.44$  volt vs. the saturated calomel electrode in a solution buffered at pH 4.0 with acetate. The method is sensitive from 0.01 to 0.50 mg of Al per 50 ml, covering a range of 0.005 to 10.0% Al. (auth)

1030

**THE RAPID SEPARATION AND ESTIMATION OF TITANIUM BY MEANS OF ETHYLENEDIAMINETETRA-ACETIC ACID.** W. F. Pickering. *Anal. Chim. Acta* **9**, 324-9(1953). Oct. (In English)

Titanium is accurately and rapidly separated from large quantities of Fe and other metallic cations by precipitation from an ammoniacal solution containing excess di-sodium salt of (ethylenediamine)tetraacetic acid, with ions being used to accelerate precipitation. The Ti may then be determined colorimetrically using the yellow color developed by  $H_2O_2$ . (auth)

1031

**POTENTIOMETRIC DETERMINATION OF TITANIUM WITH VANADIUM.** M. C. Steele and F. M. Hall. *Anal. Chim. Acta* **9**, 384-8(1953). Oct. (In English)

Ti and V may be determined in the same sample by removing the interfering elements, such as Fe, by the Hg cathode method of deposition, reducing the Ti and V with Zn, adding to a ferric solution, and titrating potentiometrically with permanganate. (auth)

#### CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

1032

**HAFNIUM OXIDE,  $HfO_2$  (MONOCLINIC).** S. Geller and E. Corenzwit. *Anal. Chem.* **25**, 1774(1953). Nov.

X-ray, optical, and morphological data for monoclinic  $HfO_2$  prepared by direct combination of a very small amount of high purity Hf with  $O_2$  at  $1100^\circ C$  in a closed-end Pt-Rh wound resistance furnace are presented. (J.A.G.)

#### FLUORINE AND FLUORINE COMPOUNDS

1033

Michigan State Coll.

**AN INVESTIGATION OF CERTAIN PHYSICAL PROPERTIES OF HALOGEN FLUORIDES** (thesis). Herbert Bradford Thompson, Jr. 1953. 204p. Contract AT(11-1)-151. (AECU-2752)

Procedures and equipment for handling halogen fluorides and for measurement of conductivities, dielectric constants, and freezing points of these compounds have been developed. Freezing point, conductivity, and dielectric constant data have been obtained for  $IF_5$ , and the dielectric constant of  $ClF_3$  has been determined. The freezing point of  $IF_5$  is  $9.425 \pm 0.01^\circ C$ , somewhat lower than the previously published value,  $9.6^\circ C$ . From the shape of the freezing curve, the solute (impurity) content of the purified  $IF_5$  was estimated at 0.0025 molal. The freezing-point depression for an 0.0147 molal solution of HF in  $IF_5$  was less than that expected on the basis of theory; this might be explained on the basis of an association of HF molecules in this solvent. The conductivity of  $IF_5$  was found to be  $1.92 \pm 0.02 \times 10^{-5}$  ohm/cm. Conductivities of several solutions of HF in  $IF_5$  were determined; while these solutions were somewhat more conducting than the pure solvent, it appeared that HF cannot be treated as an electrolyte in  $IF_5$ . The dielectric constant of liquid  $ClF_3$  in the temperature range 0 to  $25^\circ C$  is given by  $\epsilon_t = 4.754 - 0.0187 t$  and that of  $IF_5$  from 12 to  $32^\circ C$  is given by  $\epsilon_t = 46.22 - 0.388 t$ . For both compounds, the molecular dipole moments calculated from these data were significantly higher than moments from other sources. There is reason to believe that these discrepancies result from intermolecular association in these two liquids. (auth)



1034

Los Alamos Scientific Lab.

INFRARED ABSORPTION SPECTRA OF AQUEOUS  $\text{HF}_2^-$ ,  $\text{DF}_2^-$ , AND  $\text{HF}$ . Llewellyn H. Jones and Robert A. Penneman. [1953] 7p. Contract W-7405-eng-36. (AECU-2761)

Both  $\text{HF}_2^-$  and  $\text{DF}_2^-$  have characteristic infrared absorption peaks in aqueous solution with  $\nu_2$  shifted to higher and  $\nu_1$  shifted to lower frequencies than in the respective solids. Nearly saturated solutions of  $\text{KHF}_2$  (3 to 4F) show additional absorption attributed to ions such as  $\text{H}_2\text{F}_3^-$ . Addition of excess  $\text{HF}$  increases the amount of these polymeric species. A similar behavior is noted for  $\text{DF}_2^-$ . Aqueous  $\text{HF}$  at concentrations of 6F and greater shows increasingly stronger infrared absorption at  $1820\text{ cm}^{-1}$  which is not shifted in  $\text{D}_2\text{O}$ . Weak absorption of the  $\text{HF}_2^-$  ion is also observed. (auth)

1035

DETERMINATION OF FLUORIDES; SPECTROPHOTOMETRIC ADAPTATION OF METHOD OF ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS. Joseph M. Icken and Bernard M. Blank. *Anal. Chem.* **25**, 1741-2(1953). Nov.

The proposed spectrophotometric method for determining fluorides after prior isolation from food samples is based on the principle of bleaching the Th-alizarin lake by fluoride ions. By modification of the color reagent the determination may be made with an Evelyn photoelectric colorimeter. Accurate and reproducible estimations of fluorides in concentrations as low as  $0.05\text{ }\mu\text{g/ml}$  with the spectrophotometer or  $0.1\text{ }\mu\text{g/ml}$  with the photoelectric colorimeter may be obtained. It has the advantage that it employs standard laboratory equipment and does not necessitate the use of 20-mm or 50-mm cells as required by other published spectrophotometric procedures. (J.A.G.)

1036

HYDROGEN FLUORIDE SOLVENT SYSTEM; APPARATUS FOR POLAROGRAPHIC STUDIES; ROTATING ELECTRODE. John W. Sargent, Alan F. Clifford, and Warren R. Lemmon. *Anal. Chem.* **25**, 1727-9(1953). Nov.

The extreme acidity of  $\text{HF}$  makes it difficult to construct satisfactory apparatus for precision measurements. Suitable design principles for an apparatus to study liquid hydrogen fluoride solutions conveniently without fear of corrosion or contamination have been attained. The equipment should be fabricated from Kel-F (polytrifluorochloroethylene), thus permitting visual observation and allowing solutions acidic toward  $\text{HF}$  to be studied. As an example, a polarographic cell with a rotating microelectrode has been found to operate satisfactorily. An apparatus so designed is versatile and adaptable and should facilitate future studies in the  $\text{HF}$  system. (auth)

1037

ABSORPTION CELLS FOR USE WITH HYDROGEN FLUORIDE AND HALOGEN FLUORIDE SOLUTIONS. Joseph J. Katz and Herbert H. Hyman. *Rev. Sci. Instr.* **24**, 1066-7 (1953) Nov.

It has not been possible until recently to study the absorption spectra of solutions of  $\text{HF}$  or of the liquid halogen halides because of the reactivity of these compounds with quartz or glass. Methods are described in this note for preparing and assembling absorption cells utilizing chlorotrifluoroethylene polymers as windows, which can be used in Beckman or Cary spectrophotometers making it feasible to study the absorption spectra over the entire range of wavelengths. (L.M.T.)

## GRAPHITE

1038

NEW MOLECULAR COMPOUNDS OF GRAPHITE. R. C.

Croft. *Nature* **172**, 725-6(1953). Oct. 17.

Compounds of graphite with  $\text{FeCl}_3$ , chromyl chloride, chromyl fluoride, and  $\text{AlCl}_3$  have been previously reported. The successful preparation of many compounds of the same type is reported in this note. (L.M.T.)

## LABORATORIES AND EQUIPMENT

1039

Atomic Energy Research Establishment, Harwell, Berks (England)

THE THEORY OF THE D.C. ELECTROMAGNETIC FLOW-METER FOR LIQUID METALS. J. A. Shercliff. Nov. 1952. 31p. (AERE-X/R-1052)

In practical electromagnetic flowmeters the ratio of voltage output to flow quantity times field intensity is not a simple constant. This report investigates theoretically the variations of this ratio due to wall conductivity, contact resistance, the shortness of magnet pole faces, and the distortion of the velocity profile by electromagnetic forces in tubes of circular and rectangular section. Several points are still obscure, particularly the behavior of turbulence. Some recent tests are examined in the light of the theory, and the influence of dimensionless groups is discussed. It is shown that the design of an accurately predictable flowmeter is possible, although such a meter would be uneconomic for routine use. (auth)

1040

Geological Survey

A MULTIPLE CONE SPLITTER FOR RAPID SAMPLING IN THE LABORATORY. Richard Kellagher. Oct. 1953. 14p. (TEI-371)

The multiple-cone sample splitter, constructed of three powder funnels and three brass cones mounted alternately in a vertical column over a tray containing small sector-shaped retainers, obtains representative sample fractions of 5 to 50% in one operation. The use of this type of sample splitter reduces the time consumed in more conventional methods of sample splitting by about 75 to 80%. (auth)

## RADIATION CHEMISTRY

1041

Brookhaven National Lab.

CHEMICAL EFFECTS OF ELECTRON CAPTURE BY "SOLUTES IN HYDROCARBONS DURING GAMMA IRRADIATION. R. R. Williams, Jr. and W. H. Hamill, Brookhaven National Lab. and Univ. of Notre Dame. [1953]. 15p. (BNL-1584)

Dilute solutions in cyclohexane, benzene, or toluene of  $\text{CH}_3\text{I}$ ,  $\text{CH}_3\text{Br}$ ,  $\text{C}_2\text{H}_5\text{I}$ ,  $\text{C}_2\text{H}_5\text{Br}$ ,  $\text{C}_2\text{H}_5\text{Cl}$ ,  $(\text{C}_2\text{H}_5)_2\text{O}$ ,  $\text{C}_2\text{H}_5\text{OH}$ ,  $\text{CH}_3\text{COOH}$ , and  $\text{SO}_2$  individually and also several binary solute combinations were irradiated by a  $\text{Co}^{60}$   $\gamma$  source. Methyl, ethyl, and higher organic radicals were detected by reaction with  $\text{I}_2^{131}$ , present during irradiation at  $\sim 10^{-4}$  mole fraction, followed by fractional distillation with carriers. Results indicate electron capture by all solutes except  $(\text{C}_2\text{H}_5)_2\text{O}$  and  $\text{C}_2\text{H}_5\text{OH}$ . Limited evidence indicates  $\sim 10^3$  collisions by the electron before capture by the parent ion in the pure hydrocarbon. (auth)

1042

RADIATION CHEMISTRY. J. L. Magee. *Ann. Rev. Nuclear Sci.* **3**, 171-92(1953).

The principal mechanisms involved in the chemical action attributable to irradiation with sources in common use such as  $\gamma$  rays, electrons,  $\alpha$  particles, and  $\beta$  particles are discussed. Generally speaking, concern is made with the effects of ionization and electronic excitation since these usually determine the significant chemical changes resulting from irradiation. Among the topics omitted is the spe-



cial field of chemical effects following nuclear transformation, which is reviewed by Willard in this volume of *Annual Review of Nuclear Science*. 161 references. (L.M.T.)

1043

CHEMICAL EFFECTS OF NUCLEAR TRANSFORMATIONS. John E. Willard. *Ann. Rev. Nuclear Sci.* 3, 193-220(1953).

The recent work regarding the chemical changes resulting when nuclear-transformation-product atoms dissipate their excess energies in surrounding media is surveyed and correlated. Emphasis is placed on  $(n, \gamma)$  reactions in liquid and solid organic media, gas phases, and oxy-anions of inorganic salts. Reactions initiated by isomeric transition and reactions involving a change in atomic number of the reacting atom are briefly treated. The results of the few studies of  $(\gamma, n)$  reactions are summarized. Finally, neutron energy and isotope effects and the effects of background radiation are discussed. 116 references. (L.M.T.)

## RADIATION EFFECTS

1044

THE EFFECT OF X-RAYS ON GLUCOSE. P. Holtz and J. P. Becker. Translated from *Arch. Exptl. Pathol. Pharmacol.* 182, 160-3(1936). 5p. (AERE-Trans-11/3/5/377)

X irradiation of an aqueous solution of glucose was found to produce a substance which discolors methylene blue and gives, in a phosphate buffer solution, a characteristic absorption spectrum. Results are compared with data on solutions of arabinose, fructose, and glycerol following exposure to ultraviolet light, and possible reaction mechanisms are discussed. (C.H.)

1045

EFFECT OF IRRADIATION BY X-RAY UPON ANAEROBIC GLYCOLYSIS IN SPLEEN HOMOGENATES. Jean Hickman and Gilbert Ashwell. *J. Biol. Chem.* 205, 651-9(1953). Dec.

A study of the glycolytic enzymes in spleen homogenates prepared from mice exposed to lethal whole-body x irradiation showed that triosephosphate dehydrogenase was unaffected, phosphorylation coupled to the oxidation of triosephosphate was decreased, glycolysis proceeding from hexosediphosphate to lactic acid was interrupted by the increased destruction of the adenine nucleotide phosphate acceptor, and the adenylic acid which disappeared was completely accounted for as the sum of adenosine, hypoxanthine, and hypoxanthine riboside. (auth)

## RARE EARTHS AND RARE-EARTH COMPOUNDS

1046

THE DECOMPOSITION OF HYDROGEN PEROXIDE BY CERIC SALTS. PART I. THE ACTION OF CERIC SULPHATE. Shalom Baer and Gabriel Stein. *J. Chem. Soc.*, 3176-9(1953) Oct.

In the pH range of 0 to 1.4 the reaction between solutions of  $\text{Ce}(\text{SO}_4)_2$  and  $\text{H}_2\text{O}_2$  can be represented by two processes: (1)  $\text{CeO}_2 + \text{Ce}^{+4} \rightarrow \text{HO}_2 + \text{H}^+ + \text{Ce}^{+3}$  and (2)  $\text{HO}_2 + \text{Ce}^{+4} \rightarrow \text{O}_2 + \text{H}^+ + \text{Ce}^{+3}$  without consideration of the actual state of the reacting entities in the solution. It is shown that reoxidation of the  $\text{Ce}^{+3}$  formed does not occur at all and that the reaction  $\text{H}_2\text{O}_2 + \text{HO}_2 \rightarrow \text{H}_2\text{O} + \text{O}_2 + \text{OH}$  does not take place at an appreciable rate; OH radicals are proved to be absent from the system, which thus serves as a source of  $\text{HO}_2$  radicals alone. Some experiments using  $\text{Ce}(\text{ClO}_4)_4$  solutions are described which indicate that the formation of a stable peroxide complex in this case modifies the reaction with  $\text{H}_2\text{O}_2$ . (auth)

1047

SEPARATION OF CERIUM FROM THE RARE EARTHS BY

PRECIPITATION AS IODATE FROM HOMOGENEOUS SOLUTION. Hobart H. Willard and Sylvia T'sai Yu. *Anal. Chem.* 25, 1754-6(1953). Nov.

A dense, crystalline precipitate of  $\text{Ce}(\text{IO}_3)_4$  was obtained by oxidation of  $\text{Ce}(\text{III})$  to  $\text{Ce}(\text{IV})$  by either bromate or persulfate. The use of both these reagents was investigated in detail. The following factors which influence the precipitation were studied: concentration of  $\text{HNO}_3$ , temperature, concentration of  $\text{NH}_4\text{IO}_3$ , concentration of bromate or persulfate, volume of solution, stirring, and wash solutions. In general, the persulfate method gave a better separation of Ce from rare earth elements than bromate, and in general, the presence up to 30 mg of any rare earth oxide introduced no appreciable error in the persulfate method if two precipitations were made. If the volume was increased, considerably larger amounts were tolerated. Interfering elements are discussed. (J.A.G.)

1048

COLORIMETRIC DETERMINATION OF LOW QUANTITIES OF CERIUM IN URANIUM. J. Huré and R. Saint James-Schonberg. *Anal. Chim. Acta* 9, 415-24(1953) Nov. (In French)

After extraction of the Fe and U thiocyanates by ethyl acetate, the solution is oxidized by ammonium persulfate (in the presence of  $\text{AgNO}_3$ ). The absorption of this solution is measured at 360 mμ by comparison with that of an aliquot previously reduced with oxalic acid, which selectively reduces Ce and Mn to the low valences. The absorption of Mn is deduced from a measurement at 525 mμ. By this method 1 to 5 μg/ml Ce can be determined with an error of less than 15%. (auth)

## SEPARATION PROCEDURES

1049

SEPARATION TECHNIQUES USED IN RADIOCHEMISTRY. Peter C. Stevenson and Harry C. Hicks. *Ann. Rev. Nuclear Sci.* 3, 221-34(1953).

The major chemical techniques now in general use for the preparation and identification of the hundreds of radioactive species are surveyed. Measurement of radiation and the errors which may arise therefrom are not discussed; neither are the problems which arise in the synthesis of organic molecules labeled in specific positions with radioactive C atoms. 140 references. (L.M.T.)

1050

SOLVENT EXTRACTION SEPARATIONS OF ZIRCONIUM AND NIOBIUM. Edith M. Scadden and Nathan E. Ballou. *Anal. Chem.* 25, 1602-4(1953). Nov.

The extraction characteristics of a variety of solvent systems have been examined for the purpose of finding a method for quickly and efficiently isolating Zr and Nb from all other fission product elements. The mixed butyl phosphoric acids in di-n-butyl ether were found effective for this purpose. Conditions have been established for rapidly and efficiently separating both macro and carrier-free concentrations of these two elements from each other and from nearly all other fission product elements. Application of the solvent system to other separations is indicated. Conditions for simply separating the Y from the La group rare earths have been found. (auth)

1051

FRACTIONATION OF BARIUM-RADIUM MIXTURES AS CHROMATES. Murrell L. Salutsky, Joseph G. Stites, Jr., and A. W. Martin. *Anal. Chem.* 25, 1677-81(1953). Nov.

Fractional precipitation from homogeneous solution was investigated as a method for the rapid concentration of Ra from Ba-Ra mixtures. When chromates were homogeneously precipitated, Ra concentrated in the crystals with a logarithmic type of distribution. Homogeneous precipitation re-



sulted when  $\text{HNO}_3$  solutions of the chromates were gradually neutralized, using urea or  $\text{KOCN}$  as an internal reagent to generate  $\text{NH}_3$  uniformly throughout the solution. Experiments indicated that the separation is improved by decreasing the temperature at which the precipitations are made, but is not affected by the composition (Ba-Ra ratio) of the original mixture or the concentration of Ba in solution. In order to compare the separation obtained by the fractionation of various salts, regardless of the precipitation conditions, a theory is presented based on the determination of limiting distribution coefficients. The separation obtained per fractionation step by the homogeneous chromate procedure was equivalent to that obtained by the fractional crystallization of the bromides and better than that by the fractionation of the chlorides or nitrates. (auth)

1052

THE SEPARATION OF TECHNETIUM FROM MOLYBDENUM, COBALT AND SILVER. Norris F. Hall and Don H. Johns. *J. Am. Chem. Soc.* **75**, 5787-91(1953). Dec. 5.

In order to study the chemistry of Tc formed by the neutron bombardment of Mo the Tc had to be separated from its Mo matrix. This also involved the separation of radioactive trace impurities. The separation was accomplished by means of the Amberlite ion-exchange resins IRA 400 and IR 120. Co and Ag were identified as the trace impurities by determining approximately the energies of their  $\beta$  particles and by carrying the radioactivity on inert Co and Ag compounds to constant specific activity. The Tc was obtained as  $\text{NH}_4\text{TcO}_4$  free from radioactive impurities. Quantitative analysis by counting techniques showed that the concentration of Tc in this sample of Mo was about  $10 \mu\text{g/g}$ . This method is an example of the separation and determination of a radioelement formed in trace amounts by bombardment of large amounts of another element. (auth)

1053

UTILIZATION OF AMINO-POLYACETIC ACID FOR THE PURIFICATION OF SCANDIUM BY ION EXCHANGE. Vasudeva K. Iya and Jean Lorient. *Compt. rend.* **237**, 1413-15(1953) Nov. 30. (In French)

As Sc minerals always contain a certain amount of rare earths, chemical purification is difficult. A very good separation is obtained by eluting the resin, on which Sc and the rare earths were fixed at a pH of 1.8, with nitrilotriacetic acid or ethylenediaminetetraacetic acid. (J.S.R.)

#### SORPTION PHENOMENA

\*1054

Livermore Research Lab., Calif. Research and Development Co.

THE QUALITATIVE ANIONIC BEHAVIOR OF A NUMBER OF METALS WITH AN ION EXCHANGE RESIN, "DOWEX 2." H. G. Hicks, R. S. Gilbert, P. C. Stevenson, and W. H. Hutchin. Issued Dec. 1953. 10p. Contract AT(11-1)-74. (LRL-65)

The qualitative behavior of anionic species of a number of metal ions has been studied by means of an anion-exchange resin, "Dowex 2." Metals have been segregated into groups according to their elution behavior with various concentrations of  $\text{HCl}$ ,  $3\text{M HClO}_4$ ,  $1\text{M NH}_4\text{OH}$ , and  $1\text{M NaOH}$ . The advantages of this grouping is discussed with particular reference to radiochemical separations. (auth)

1055

SORPTION OF NON-ELECTROLYTE MOLECULES BY PROTEINS. A. G. Pasynskii and R. C. Chernyak. Translated by Gregory Belkov from *Doklady Akad. Nauk. S.S.S.R.* **73**, 771-4(1950). 8p. (AEC-tr-992; TT-216)

Sorption isotherms were determined for such organic substances as urea, guanidine, and urethan by various globular

and fibrous proteins. The dialysis equilibrium method was used, and after equilibrium was established the external liquid in the ampoules was analyzed for the content of the given non-electrolyte with a Zeiss interferometer calibrated with solutions of known content. Data are presented in tabular form. (C.H.)

1056

ADSORPTION OF OXYGEN ON PLATINUM DURING POLARIZATION BY THE CHARGING CURVES. (Adsorbtsiya Kisloroda na Platine pri Polyarizatsii po Krivym Zaryasheniya) Ts. I. Zalkind and B. V. Ershler. Translated by Esther Rabkin from *Zhur. Fiz. Khim.* **25**, 565-76 (1951). 26p. (TT-283)

#### SYNTHESES

\*1057

Radiation Lab., Univ. of Calif., Berkeley  
PREPARATION OF DIETHYL MALONATE-2- $\text{C}^{14}$ . Doris Chin and Patricia Adams. Nov. 1953. 12p. Contract W-7405-eng-48. (UCRL-2394)

Diethyl malonate-2- $\text{C}^{14}$  was prepared in 60 to 70% yield from sodium acetate-2- $\text{C}^{14}$  via chloroacetic, cyanoacetic, and malonic acids and Ag salt esterification of the malonic acid. (auth)

#### TRANSURANIC ELEMENTS AND COMPOUNDS

1058

Radiation Lab., Univ. of Calif., Berkeley  
TRANSCURIUM ISOTOPES PRODUCED IN THE NEUTRON IRRADIATION OF PLUTONIUM. S. G. Thompson, A. Ghiorso, B. G. Harvey, and G. R. Choppin. Dec. 10, 1953. 5p. Contract W-7405-eng-48. (UCRL-2433)

A 6.6-Mev  $\alpha$  activity, observed as a result of neutron bombardment of  $\text{Pu}^{239}$ , has been assigned to element 99. A fraction just preceding the Cf in elution from the hot Dowex-50 resin column was found to contain 6.15-, 6.05-, and 5.8-Mev activities, attributed to Cf isotopes heavier than 248. A soft  $\beta$  radiation from the Bk fraction was assigned to  $\text{Bk}^{240}$ , formed by  $\text{Cm}^{240}$  decay. A possible sequence leading to the production of element 99 from ( $n,\gamma$ ) reaction with  $\text{Pu}^{239}$  is suggested. (K.S.)

1059

THE ACTINIDE-LANTHANIDE ANALOGY AS EXEMPLIFIED BY SOLVENT EXTRACTION BEHAVIOR. D. F. Peppard, P. R. Gray, and M. M. Markus. *J. Am. Chem. Soc.* **75**, 6063-4(1953) Dec. 5.

A comparison of the solvent extraction behavior of the lanthanides and actinides was made for the purpose of pointing out similarities between the two series in the trivalent state. The experiments show that  $\log K$  is a linear function of atomic number for both lanthanides(III) and actinides(III). The Am behavior parallels that of Pm in the nitric acid dependency of  $K$  and in the third power dependence of  $K$  on TBP concentration. (J.S.R.)

#### TRITIUM AND TRITIUM COMPOUNDS

1060

Chicago Univ.  
RESEARCH TO ASSAY RAIN AND SURFACE WATER FOR NATURAL TRITIUM CONTENT. QUARTERLY PROGRESS REPORT FOR PERIOD SEPTEMBER 1, 1953 THROUGH NOVEMBER 30, 1953. [W. F. Libby]. Dec. 1, 1953. 2p. Contract AF-18(600)-564. (NP-4990)

The results of assays for natural tritium content of rain and surface waters at various locations, and wines of various vintages and from various locations, are tabulated. (For preceding period see NP-4791.) (C.H.)



## URANIUM AND URANIUM COMPOUNDS

1061

SAM Labs.

THE PHYSICAL PROPERTIES OF URANIUM HEXA-FLUORIDE. I. Kirshenbaum. July 1, 1943. 52p. (2R-464). ADDENDUM TO REPORT A-753. I. Kirshenbaum. Oct. 26, 1943. 6p. (2M-503). Both sections decl. Nov. 30, 1953. Contract W-7405-eng-50. (A-753; 2R-464; 2M-503)

A study was made of all the available information on the physical properties of  $UF_6$ . The data were evaluated, and wherever possible thermodynamic correlations and tests for consistency were made. The results are given in this report. (auth)

1062

EVIDENCE FOR PENTAVALENT URANIUM AS AN INTERMEDIATE IN THE REACTION IN WATER BETWEEN PHOTOACTIVATED URANYL IONS AND SUCROSE AND CLOSELY RELATED SUBSTANCES, AND QUANTUM YIELDS FOR THESE REACTIONS. Lawrence J. Heidt and Kenneth A. Moon. *J. Am. Chem. Soc.* **75**, 5803-9(1953). Dec. 5.

It has been discovered that photoactivated uranyl ions react in water with sucrose and closely related substances to produce presumably the +5 state of U, which subsequently disproportionates thermally into the +4 and +6 states. Quantum yields have been measured for the reduction of the uranyl ions and have been found to be independent of the concentration of uranyl ion, but to increase with the concentration of carbohydrate. This behavior has been interpreted quantitatively in terms of simple reactions. The reactions were carried out at 25° with light of 2537 Å. Photoactivated uranyl ions do not appear to react with uranous ions to produce U(V) in perchlorate solutions at a pH between one and two. The carbohydrate materials employed were: sucrose, D-fructose, D-glucose, D-gluconic acid, and the methyl glycosides:  $\beta$ ,L-arabinopyranoside,  $\alpha$ ,D-fructofuranoside,  $\alpha$ ,D-glucopyranoside and  $\alpha$ ,D-mannopyranoside. Complexes of uranous ion with glucose and the methyl glucoside have been identified and their association constants have been estimated. (auth)

1063

URANIUM OXIDE PHASE EQUILIBRIUM SYSTEMS. III.  $UO_2$ - $ZrO_2$ . W. A. Lambertson and M. H. Mueller. *J. Am. Ceram. Soc.* **36**, 365-8(1953) Nov.

The  $UO_2$ - $ZrO_2$  phase equilibrium system contained no new compounds but was found to contain extensive solid solution. The  $UO_2$  solid solution was cubic and extended up to 52 mole %  $ZrO_2$ . Its lattice parameter varied from 5.46 to 5.32 atomic units with an increasing percentage of  $ZrO_2$ . The zirconia solid solution when examined by quenching techniques was tetragonal and extended from 53 to 100%  $ZrO_2$ . There were some indications that  $ZrO_2$  transformed to a polymorphic form other than monoclinic or tetragonal at approximately 1900°C. (auth)

## ENGINEERING

## HEAT TRANSFER AND FLUID FLOW

1064

Nuclear Development Associates, Inc.

TURBULENT HEAT TRANSFER IN POLYGONAL FLOW SECTIONS. Harold G. Elrod, Jr. Sept. 22, 1953. 62p. (NDA-10-7)

1065

Nuclear Development Associates, Inc.

HEAT TRANSFER TO WATER AT 5000 PSIA FLOWING

TURBULENTLY IN ROUND TUBES. Kurt Goldmann. Sept. 23, 1952. 40p. (NDA-10-8)

A summary of preliminary results of heat transfer and shear-stress calculations made for water flowing turbulently in round tubes at a pressure of 5000 psia is presented. A computation procedure is outlined which has been used in applying a new analytical method for predicting heat transfer and friction characteristics of fluids with temperature-dependent properties. (J.E.D.)

1066

Nuclear Development Associates, Inc.

BOILING SONGS. Kurt Goldmann. May 14, 1953. 23p. (NDA-10-68)

Longitudinal tube-wall-temperature profiles observed experimentally at Pratt and Whitney while heating  $H_2O$  at supercritical pressures and high heat fluxes looked remarkably similar to profiles obtained at subcritical pressures with boiling occurring toward the end of the heating tubes. It was hypothesized that a boiling-like phenomenon can occur at supercritical pressures. Whenever the boiling-like profiles were observed, a singing sound could also be heard, and it appears that the sounds originate in the heated tubes themselves and are not generated by rubbing surfaces. Definite and tentative conclusions are presented from the studies and from information obtained in visits with boiling experts at other installations. (L.M.T.)

1067

Armour Research Foundation

STUDY OF EFFECTS OF TURBULENCE PROMOTERS ON HEAT TRANSFER. FINAL REPORT. A. Shaffer and O. E. Teichmann. Aug. 3, 1950. 79p. [Contract W-33-08-ac-14801(16250)]. (NEPA-1559)

1068

Massachusetts Inst. of Tech.

BOILING HEAT TRANSFER PROJECT. PROGRESS REPORT [FOR] OCTOBER 1953. Joseph B. Walsh and Milton W. Raymond. Nov. 1, 1953. 6p. Contract N5-ori-07827. (NP-4987)

Progress is reported on modification and testing of equipment for use in the visual-density and burnout programs. No specific data are given. (For preceding period see NP-4926.) (L.M.T.)

\*1069

Oak Ridge National Lab.

UNSTEADY STATE FLOW OF STEAM FROM A HIGH PRESSURE SYSTEM. Wayne S. Brown. Issued Dec. 10, 1953. 60p. Contract W-7405-eng-26. (ORNL-1604)

A method is presented for determining heat removal from a boiling liquid in the form of vapor and the amount of liquid entrained in the vapor as a result of the high heat-release rates. The term heat-release rate is defined as the product of the vapor-flow rate and the latent heat of the liquid. An experiment was performed with water as the fluid. To achieve high heat-release rates, a closed vessel containing saturated liquid and saturated vapor at high pressure was vented to the atmosphere through a restricting tube. An analytical method is presented for determining flow rate and rate of pressure change. Temperature measurements were made to determine the condition of the vapor leaving the system and the approximate location of the boiling level. Tests were made at initial pressures of 1540 and 540 psia and with initial weights of 2, 4, and 6 lb. The highest heat-release rate obtained was 758 Btu/sec/ft<sup>2</sup>. Pressure drop vs. time, flow rates, and heat-release rates are discussed. (J.A.G.)

1070

Radiation Lab., Univ. of Calif., Livermore

A NUMERICAL METHOD FOR TWO-DIMENSIONAL



LAGRANGIAN HYDRODYNAMICS. Bryce S. DeWitt. Dec. 10, 1953. 8p. Contract W-7405-eng-48. (UCRL-4250)

A completely Lagrangian scheme for differencing hydrodynamical equations in two dimensions is described. The method conserves mass exactly. The advantages of Lagrangian over Eulerian schemes are briefly mentioned. An appendix gives the generalization to three dimensions. (auth)

#### MATERIALS TESTING

\*1071

General Engineering Lab., General Electric Co. COLLISION OF PLATES. H. Poritsky and M. F. Bolster. Nov. 1, 1953. 31p. Contract W-31-109-eng-52. (GEL-77; R53GL226)

The theory of collision of plates based on linear elasticity is reviewed and applied to collision of plates of the same and of different thickness. The coefficient of restitution is calculated in each case. (auth)

#### VACUUM SYSTEMS

1072

Commissariat à l'Énergie Atomique UTILISATION DE MEMBRANES EN TECHNIQUE DU VIDE. [UTILIZATION OF MEMBRANES IN VACUUM TECHNIQUE]. P. Prugne and P. Garin. Feb. 1953. 6p. (CEA-164)

Several examples are described for the application of flexible membranes to vacuum techniques, with a method for gluing such membranes to Perbunan and metal. (tr-auth)

\*1073

Knolls Atomic Power Lab. STATIC SEAL STUDIES. W. A. Heywood. June 1953. 55p. Contract W-31-109-eng-52. (KAPL-974)

Helium leak rates were determined by a mass spectrometer method for a static seal using Koroprene, Neoprene type TR, and Hycar square-cross-section seal rings and a standard "O" ring having a circular cross section. The pressure drop across the seal was 65 psi in all cases. Leakage values ranged from  $\sim 7 \times 10^{-2}$  cc/min for the Koroprene ring to  $2.7 \times 10^{-5}$  cc/min for a Hycar seal ring in a specially designed groove. These leak rates are of the same order as would be expected from diffusion of He through the elastomer. These values can be compared with leak rates obtained by metallic seals. For example, the leak rate of a  $7\frac{1}{4}$ -in.-diam. gasket made of 64-mil.-diam. Al wire was found to be of the order of  $2 \times 10^{-9}$  cc/min. (auth)

## MINERALOGY, METALLURGY, AND CERAMICS

#### CERAMICS AND REFRACTORIES

1074

Research Foundation, Ohio State Univ. IMPREGNATION OF CARBIDE SKELETAL BODIES WITH SELECTED METALS OR ALLOYS. Earle T. Montgomery, Thomas S. Shevlin, Clinton C. McBride, Robert F. Stoops, Howard E. Konrad, and William S. Zartman. May 1951. 124p. Contract AF 33(038)-6841. (AF-TR-6515; ATI-117781)

\*1075

Massachusetts Inst. of Tech. THE MEASUREMENT OF THERMAL CONDUCTIVITY OF

REFRACTORY MATERIALS. THERMAL CONDUCTIVITY. PART 8. A THEORY OF THERMAL CONDUCTIVITY OF POROUS MATERIALS. Arthur L. Loeb. 16p. PART 9. EXPERIMENTAL INVESTIGATION OF THE EFFECT OF POROSITY ON THERMAL CONDUCTIVITY. J. Franci and W. D. Kingery. 18p. PART 10. DATA FOR SEVERAL PURE OXIDE MATERIALS CORRECTED TO ZERO POROSITY. W. D. Kingery, J. Franci, R. L. Coble, and T. Vasilos. 8p. F. H. Norton, director. Sept. 30, 1953. 62p. Contract AT(30-1)-960. (NYO-3647)

A THEORY OF THERMAL CONDUCTIVITY OF POROUS MATERIALS. The effective thermal conductivity of a porous material is due to both conduction and radiation processes. A theory is presented relating the effective conductivity to the conductivity of the solid material, the emissivity of the surface of the pores, and to the size, shape, and distribution of the pores. By means of an anisotropic distribution and orientation of pores, materials can be prepared having different thermal conductivities in different directions. EXPERIMENTAL INVESTIGATION OF THE EFFECT OF POROSITY ON THERMAL CONDUCTIVITY. The effect of isometric approximately spherical pores and anisometric cylindrical pores on the thermal conductivity of alumina, graphite, and Ni has been investigated. Pore orientation is found to profoundly affect thermal conductivity for a given porosity. At temperatures below about 500°C, the conductivity of a porous sample in any given direction is equal to the solid conductivity times one minus the cross-sectional pore fraction. At higher temperatures, the pore size and emissivity become important. DATA FOR SEVERAL PURE OXIDE MATERIALS CORRECTED TO ZERO POROSITY. Thermal conductivities have been measured for several ceramics. Data for 15 pure oxides have been calculated for theoretical density. Tables and plots of thermal conductivity from 100 to 1800°C are included. The conductivity variation between polycrystalline oxide materials decreases from a factor of more than 100 to 1 at room temperature to about 10 to 1 above 1000°C. (auth)

\*1076

Massachusetts Inst. of Tech. THE MEASUREMENT OF THERMAL CONDUCTIVITY OF REFRACTORY MATERIALS. PROGRESS REPORT. F. H. Norton, W. D. Kingery, et al. Oct. 1, 1953. 9p. Contract AT(30-1)-960. (NYO-3648)

The theoretical and experimental investigation of the effects of porosity on thermal conductivity have been completed. Summary reports on these subjects and a compilation of data for oxide materials have been submitted. Data for a glass composition, SiC, and ZrN are given. (auth)

1077

METAL-CERAMIC INTERACTIONS. I. FACTORS AFFECTING FABRICATION AND PROPERTIES OF CERMET BODIES. W. D. Kingery. *J. Am. Ceram. Soc.* 36, 362-5 (1953) Nov.

The fundamentals of cermet fabrication and properties of cermet bodies are considered. These include metal-ceramic reactions, surface and interfacial energies, constituent properties, and the effect of the dispersed state on the properties. These factors affect metal-ceramic bonding, body composition, and phase distribution, which are important in fabrication and to properties. Strength, oxidation resistance, thermal conductivity, and thermal-shock resistance also are considered. (auth)

1078

A LIST OF CERAMIC RESEARCH PROJECTS IN 1953. *Am. Ceram. Soc. Bull.* 32, 424-31(1953). Dec.

The 1953 list of research projects compiled by the Re-



search Committee of The American Ceramic Society is a continuation of the 1951 and 1952 reports. The list includes contracts awarded to ceramic schools, research institutes, government organizations, and manufacturing concerns. (L.T.W.)

## CORROSION

\*1079

Knolls Atomic Power Lab.

CORROSION OF ZIRCONIUM AND ITS ALLOYS IN LIQUID METALS. R. F. Koenig. Oct. 1, 1953. 14p. Contract W-31-109-eng-52. (KAPL-982)

The results of corrosion tests of Zr and Zr alloys in various liquid metals under static, isothermal conditions are summarized. Stress-rupture tests of Zr alloys in filtered Na at 1000°F are tabulated. (J.E.D.)

## GEOLOGY AND MINERALOGY

1080

Utah Univ.

SEDIMENTARY PROPERTIES OF SALT WASH SANDSTONES AS RELATED TO PRIMARY STRUCTURES. PART 2. TECHNICAL REPORT FOR APRIL 1, 1952 TO MARCH 1953. William Lee Stokes and Walter Sadlick. October 31, 1953. 25p. Contract AT-30-1-1182. (RME-3067)

In the study of primary sedimentary features of the U-bearing Salt Wash sandstone of the Carrizo Mountains, representative types of sandstone were collected for sedimentary analysis. The types of sandstone, classified according to distinguishing structures or properties, are as follows: festoon, lineation, ripple, rib-and-furrow, massive, carbonaceous, and ore-bearing. Each type has been analyzed for sorting, circularity and roundness. On the assumptions that grain size and shape reflect velocity of the depositing currents, the sands can be arranged in terms of decreasing velocity of deposition as follows: festoon, massive, ore-bearing, lineation, carbonaceous, ripple, and rib-and-furrow. In general, the festoon sand is thought to originate in the central part of vigorous, turbulent stream channels and the rib-and-furrow on the flood plains in slow-moving, smoothly flowing water. The other types are considered to form in intermediate areas under a variety of environmental conditions. The ore sand is most nearly like the lineation and carbonaceous sands (if the relatively rare ripple-mark type is disregarded). It has a narrower range of sorting and contains less of the finer grades than the other sands. This is interpreted to mean it originally had greater porosity and permeability. Evidence from this study supports the conclusion that ore bodies are more likely to be found between the flood plain and the more central parts of channel sands because this environment was most favorable to plant growth and burial which in turn was favorable to ore formation. This zone can be identified with the aid of primary structures and by sedimentary analysis. (auth)

1081

Grand Junction Operations Office, AEC

INVESTIGATION OF THE "C" GROUP AREA, SAN JUAN COUNTY, UTAH. Paul C. deVergie and William A. Carlson. Issued Mar. 20, 1953. 13p. (RME-4011)

The "C" group of claims, located on the Colorado River about 20 miles southwest of Moab, Utah, were examined during November 1952. The area was mapped by plane table and extensively sampled. Uranium ore is being mined near the base of the Shinarump conglomerate, where it fills a large, deep channel cut into the Moenkopi formation. Several mineralized exposures have ore-producing possibilities and mining is active on one claim. (auth)

1082

Division of Raw Materials, AEC

PRELIMINARY REPORT OF RECONNAISSANCE IN THE

BIGHORN BASIN, NORTH-CENTRAL WYOMING AND SOUTH-CENTRAL MONTANA. Donald C. Barrett. Issued June 1953. 19p. (RME-4027)

On the basis of several reported U discoveries in favorable stratigraphic horizons similar to those in the Powder River basin, the Bighorn basin was subjected to an intensive ground and airborne reconnaissance. Sediments ranging in age from Cambrian to Lower Tertiary are exposed in the Bighorn basin and the mountain ranges surrounding it. Airborne reconnaissance was concentrated on Mesozoic and Tertiary beds which are exposed in the basin itself, while ground parties covered the rocks both in the mountains and in the basin. Uranium was found at several horizons. The most persistent occurrences are in the Mesaverde formation, Morrison-Cloverly formations, and the Flathead sandstone. Traces of U were found in the Frontier, Wasatch, and Chugwater formations. None of the occurrences found to date appears to be economic, and no further work in the Bighorn basin is planned. (auth)

1083

Division of Raw Materials, AEC

PRELIMINARY RECONNAISSANCE OF THE DRIPPING SPRING QUARTZITE FORMATION IN GILA AND PINAL COUNTIES, ARIZONA. W. E. Mead and R. L. Wells. Issued June 1953. 10p. (RME-4037)

This report is the same as RME-2003 except for a few editorial changes.

1084

Geological Survey

RECONNAISSANCE FOR RADIOACTIVE DEPOSITS IN THE FORTYMILE DISTRICT, EAST-CENTRAL ALASKA, 1949. Helmuth Wedow, Jr. and Gene E. Tolbert. Dec. 1953. 26p. (TEI-196)

A reconnaissance was conducted in the Wilson Creek, My Creek, and Ben Creek areas, Fortymile district, east-central Alaska, in 1949 in an attempt to locate three occurrences of high-grade U ores reported by prospectors. The search was unsuccessful. A maximum of 0.005% equivalent U was found in felsic igneous rocks of the Wilson Creek and Ben Creek areas. The radioactivity of these rocks in the Wilson Creek area is probably due to traces of radioactive elements in the common accessory minerals of the igneous rocks; in the Ben Creek area it is probably due chiefly to Th in monazite and allanite, which were identified in concentrates from gravels of streams draining areas underlain by the igneous rocks. Radioactivity tests of Tertiary sedimentary rocks in the vicinity of Chicken show that a sulfide-bearing montmorillonite-type clay contains as much as 0.005% equivalent U and that coked(?) coal and ash from a burned coal bed contain as much as 0.003% equivalent U. A concentrate from a gold-placer deposit at Atwater Bar, a short distance east of Chicken, submitted by a prospector contains traces of uranotorianite and monazite and has an equivalent U content of 0.027%. (auth)

1085

Geological Survey

GEOLOGY OF THE PINE MOUNTAIN QUADRANGLE, MESA COUNTY, COLORADO. Fred W. Cater, Jr. Aug. 1953. 30p., 1 illus. (TEM-704)

The Pine Mountain quadrangle is one of eighteen 7½-minute quadrangles covering the principal carnotite-producing area of southwestern Colo. The rocks exposed in the eighteen quadrangles consist of crystalline rocks of pre-Cambrian age and sedimentary rocks that range in age from late Paleozoic to Quaternary. Over much of the area the sedimentary rocks are flat lying, but in places the rocks are disrupted by high-angle faults and northwest-trending folds. Conspicuous among the folds are large anticlines having cores of intrusive salt and gypsum. Most of the carnotite



deposits are confined to the Salt Wash sandstone member of the Jurassic Morrison formation. Within this sandstone, most of the deposits are spottily distributed through an arcuate zone known as the "Uruvan Mineral Belt". Individual deposits range in size from irregular masses containing only a few tons of ore to large, tabular masses containing many thousands of tons. The ore consists largely of sandstone selectively impregnated and in part replaced by U and V minerals. Most of the deposits appear to be related to certain sedimentary structures in sandstones of favorable composition. (auth)

# METALS AND METALLURGY

\*1086

Ames Lab.

THE THORIUM-VANADIUM SYSTEM. H. L. Livingston and B. A. Rogers. Apr. 22, 1953. Decl. with deletions Nov. 16, 1953. 20p. Contract W-7405-eng-82. (AEC-3602; ISC-340)

The binary system Th-V has been investigated by x-ray, metallographic, and thermal methods of analysis. The investigation has disclosed a simple eutectic system with negligible solid solubility of either component in the other. The eutectic structure contains 5% V by weight, and the eutectic temperature is 1400°C. The melting points of Th and V were found to be 1720 and 1845°C, respectively. The temperature at which Th changes from a face-centered cubic to a body-centered cubic structure appears to be unaffected by the addition of V. (auth)

\*1087

Ames Lab.

THORIUM-TITANIUM ALLOY SYSTEM. H. A. Wilhelm, O. N. Carlson, and H. E. Lunt. June 1953. Decl. with deletions Dec. 2, 1953. 22p. Contract W-7405-eng-82. (AEC-3603; ISC-408)

The Th-Ti alloy system was investigated by x-ray, metallographic, thermal, and diffusion methods, and a phase diagram was proposed. The system is of the eutectic type with no terminal solid solubility. The eutectic temperature is 1190°C, and the eutectic composition is 12 wt. % Ti. The Ti allotropic transformation temperature is not altered by the presence of Th. The effect of Ti on the Th allotropic transformation was not studied directly, but no evidence was found to indicate appreciable solid solubility of Ti in  $\beta$  thorium. The Th liquidus and the Ti liquidus were determined experimentally and found to be smooth curves with no points of inflection. The addition of Ti to Th was found to increase the hardness of Th and decrease slightly the extent to which it may be cold rolled without intervening annealing. Ti was found to have deleterious effect on the corrosion resistance of Th to boiling distilled water. (auth)

1088

Massachusetts Inst. of Tech.

FORMABILITY AND WELDABILITY OF VAPOR-DEPOSITED MOLYBDENUM. FINAL REPORT. John Wulff, Amos Shaler, James Johnston, James Wong, Alfred Hofstatter, and William Moffatt. Oct. 31, 1952. 69p. Contract W-7405-eng-27, Sub-500. (AECU-2746)

The development of methods of working vapor-deposited Mo and of welding Mo produced either by this method or by existing arc-casting and powder-metallurgy processes is described. Some of the mechanical properties of all three kinds of Mo were measured. The element primarily responsible for embrittling Mo when it is heated above a temperature approximately equal to its recrystallization temperature is O, the deleterious effect of which becomes serious at levels as low as 0.001%. The art of fractography was advanced by improvements in technique which can

serve to reveal and perhaps to analyze oxides and other impurities present in the metal in minute quantities. The major contributions made by this study are the development of a method of cold-working vapor-deposited Mo directly from the deposits and the development of a new method of welding Mo. The welding method is applicable to arc-cast and to powder-metallurgy Mo and probably also to the vapor-deposited metal. (auth)

1089

Metals Research Lab., Case Inst. of Tech.

AN INVESTIGATION OF SCALING OF ZIRCONIUM AT ELEVATED TEMPERATURES. QUARTERLY STATUS REPORT NO. 2 [FOR] SEPTEMBER 2 TO DECEMBER 2, 1953. W. M. Baldwin, Jr., D. J. Garibotti, and E. B. Evans. Dec. 17, 1953. 5p. Contract AT(11-1)-258. (AECU-2763)

The study of the high-temperature scaling behavior of Zr in air was continued, and the construction and assembly of special equipment to study the scaling behavior of Zr in  $O_2$ ,  $N_2$ , and mixtures thereof at various temperatures was nearly completed. (For preceding period see AECU-2672.) (auth)

1090

National Gas Turbine Establishment (Great Britain)

THE RELATIONSHIP BETWEEN THE CREEP AND TENSILE PROPERTIES AT ELEVATED TEMPERATURE OF NIMONIC 80. [PART] 2. K. F. A. Wallis and A. Graham. June 1953. 27p. (NGTE-R-137)

The results of a few experiments on creep recovery enable the arguments of report NGTE-R-100 to be extended. A new form of time-temperature variable is proposed which, without change of constants, satisfactorily coordinates NPL and Mond-Nickel long-time creep data on Nimonic 80, NGTE short-time creep tests on Nimonic 80 drawn from store, and Mond-Nickel long-time data for an early heat of Nimonic 80A. Apart from this improvement, the situation previously reported is not affected. Support is given for the Andrade formula for creep. (auth)

1091

Pennsylvania State Coll. School of Mineral Industries

REFRACTORY MATERIALS FOR USE IN HIGH TEMPERATURE AREAS OF AIRCRAFT. BI-MONTHLY PROGRESS REPORT. W. H. Rice, W. H. Earhart, and N. R. Thielke. June 16, 1953. 72p. Contract AF 33(616)-139. (NP-4970; Memo Report 19)

Compositions in the system TaC-NbC-TiC were prepared from mixtures of commercial carbides or stoichiometric equivalents of metals or oxides with C. After sintering in a C-tube resistor furnace, compacts were studied by x-ray and metallographic methods to determine the nature of phases present. Oxidation resistance of the sintered specimens was investigated to determine the relative influence of TaC and NbC upon the stability of TiC. Differential thermal analysis of heat effects occurring during oxidation of mixtures of TiC with other carbides or metals was investigated. Thermal effects in Zr boride and Ni aluminide also were examined. (For preceding period see NP-4642.) (auth)

1092

New York State Coll. of Ceramics, Alfred Univ.

DIFFUSION OF COBALT, IRON AND NICKEL INTO TITANIUM CARBIDE. SUMMARY REPORT [FOR] OCTOBER 1950-JANUARY 1952. Robert C. Turnbull and W. G. Lawrence. 6p. Contract AF-33(038)-16190. (NP-4991)

1093

Battelle Memorial Inst.

A METALLURGICAL STUDY OF MOLYBDENUM. THE IMPROVEMENT OF THE DUCTILITY OF MOLYBDENUM WELDMENTS. SUMMARY REPORT COVERING THE



PERIOD AUGUST 1, 1951 TO JULY 14, 1953 AND SIXTEENTH QUARTERLY REPORT COVERING THE PERIOD MARCH 1, 1953 TO JULY 14, 1953. W. H. Kearns, L. E. Olds, D. C. Martin, and R. B. Fischer. July 14, 1953. 15p. Contract N9onr 82101. (NP-4993)

Ductile fusion welds could be made in Mo rods which had been degassed by heating them above 3500°F for long times in high vacuum. Welds were resistance butt welds. Molybdenum used was 0.25-in.-round, commercial, powder-metallurgy rod in the cold-worked condition as received. If the welds were to be ductile, very careful cleaning of the faying surfaces, preferably by electropolishing, was necessary, and welding had to be done in vacuum at pressures below 0.5  $\mu$ . Welds made at 1  $\mu$  or higher pressures were brittle. All welds made in H<sub>2</sub>, He, or Ar were brittle, even though precautions were taken to purify the gases. To provide material for welding tests, commercial vacuum-melted, C-deoxidized Mo was heated first in low-pressure O<sub>2</sub> to remove C and then in vacuum to remove O<sub>2</sub>. The C content was greatly reduced, and the metal was ductile after the treatment. Alloys have been made of Mo plus elements which are strong deoxidizers or which have a strong tendency to form nitrides, carbides, or sulfides. These alloys will be used for future welding tests. (auth)

1094

Battelle Memorial Inst.

A METALLURGICAL STUDY OF MOLYBDENUM. THE ANELASTICITY OF MOLYBDENUM. FINAL REPORT COVERING THE PERIOD MAY 1, 1950 TO JULY 14, 1953 AND SIXTEENTH QUARTERLY REPORT COVERING PERIOD MARCH 1, 1953 TO JULY 14, 1953. R. E. Maringer and A. D. Schwöpe. July 14, 1953. 49p. Contract N9onr 82101. (NP-4994)

Some factors which might affect the mechanical properties of Mo, including heat treatment, impurities, and plastic deformation, have been studied by means of internal-friction experiments in conjunction with chemical, spectrographic, and vacuum-fusion analysis and mechanical testing. Heat treatment in vacuum at high temperatures is shown to reduce the O<sub>2</sub>, N<sub>2</sub>, H<sub>2</sub>, and Ca content of Mo. Heat treatment in NH<sub>3</sub> is shown to cause a discontinuous yield point in the tensile test and various internal-friction phenomena due to the formation of a hard, brittle nitride case. Oxygen is shown to cause severe embrittlement of Mo by forming Mo<sub>2</sub>O<sub>3</sub> at the grain boundaries, although the presence of O<sub>2</sub> does not appear to embrittle single crystals. Carbon and N<sub>2</sub> are shown to cause internal-friction phenomena in cold-worked Mo, which can be related to mechanical properties such as discontinuous yield point, strain aging, and blue brittleness. (auth)

1095

Utah Univ.

EQUIPMENT FOR HIGH TEMPERATURE HIGH PRESSURE SOLID-GAS REACTION RATE STUDIES. TECHNICAL REPORT NO. 4. W. Martin Fassell, Jr. and Robert C. Peterson. Aug. 10, 1953. 19p. Contract DA-04-495-ord-237. (NP-4997)

The basic concepts of the effect of O<sub>2</sub> concentration on the rates of oxidation of metals are considered. The experimental equipment and the techniques employed at high temperatures and pressures are described in detail. Some typical oxidation rate curves are included to illustrate the precision of the methods employed. (auth)

1096

Utah Univ.

HIGH PRESSURE OXIDATION OF METALS. TECHNICAL REPORT NO. 5. TANTALUM IN OXYGEN. Robert C. Peterson, W. Martin Fassell, Jr., and Milton E. Wadsworth. Oct. 10, 1953. 31p. Contract DA-04-495-ord-237. (NP-4998)

The temperature and pressure dependence of the reaction of Ta in O<sub>2</sub> were investigated from 500 to 1000°C at pressures from 10 mm Hg to 600 psi total O<sub>2</sub> pressure. Ta was found to oxidize linearly under the above conditions. Three distinct regions of temperature dependence were found with different energies of activation. From 500 to 600°C the rate of oxidation of Ta was found to be essentially independent of the O<sub>2</sub> pressure at the pressure investigated. From 600 to 800°C the oxidation rate increases rapidly with an increase in pressure. The dependence of the oxidation rate on the bulk concentration may be expressed by  $V = k'O$  where  $k'$  is the specific rate constant and

$$\theta = \frac{k_1 \text{CO}_2}{1 + k_1 \text{CO}_2},$$

where  $k_1$  is the equilibrium constant for the adsorption of O<sub>2</sub> on Ta. (auth)

1097

[Columbia Univ.]

ELECTROLYTIC CUTTING OF METALS. PROGRESS REPORT [FOR PERIOD] OCTOBER 1, 1950-MAY 31, 1951. Irving Moch, Jr. and George L. Kehl. 19p. Contract AT(30-1)-1006, Scope 2. (NYO-3012)

The development of an electrolytic process for sectioning or cutting solid metals is reported. The principle consists of the selective removal of metal from the anode (specimen) in an electrolytic cell appropriately arranged with respect to cathode and electrolyte. (J.E.D.)

1098

Massachusetts Inst. of Tech.

FUNDAMENTALS OF COLD WORKING AND RECRYSTALLIZATION. TECHNICAL PROGRESS REPORT NO. 12, SCOPE III. S. Allen, B. L. Averbach, and M. Cohen. Sept. 30, 1953. 4p. [Contract AT-(30-1)-1002], Scope III. (NYO-7068)

Work on deformation of Au-Ag alloys and  $\alpha$  brass single crystals is briefly summarized. (L.T.W.)

1099

Bristol Aeroplane Co., Ltd. (England)

DEVELOPMENT OF TECHNIQUE FOR METALLIC INERT ARC WELDING. FINAL REPORT. Mar. 1953. 19p. Contract 7233/CB.6(B). (S and T Memo-N-2/53)

The use of a consumable-metallic-arc automatic welding machine in the welding of Mg-Zr alloys was investigated. The machine is described in detail, and operating characteristics are discussed. Results are compared with those obtained with W electrode welding machines. A higher speed of welding was found to be possible with the consumable-arc machine, but the bead-up was found to be considerably greater. It was concluded that the increase in speed is offset by the increased material cost, the heavy bead build-up, and the 0.2-in. limit to the thickness of plate that may be welded with consistent results with the consumable-arc machine. (C.H.)

1100

General Electric Research Lab.

DEVELOPMENT OF ZIRCONIUM-BASE ALLOYS. SIXTEENTH QUARTERLY REPORT. (PROGRESS REPORT NO. 17). J. H. Keeler. Oct. 5, 1953. 5p. Contract W-31-109-Eng-52. (SO-2512; RL-980)

Tensile tests were conducted on Zr binary alloys in the temperature range -195 to 500°C. Yield-strength data are presented. Deformation textures for three Zr-Al alloys are given. The melting temperature of crystal-bar Zr has been redetermined as 1852  $\pm$  2°C. (For preceding period see SO-2511.) (auth)

1101

Northwest Electrodevelopment Lab., Bureau of Mines, Albany, Oreg.

MALLEABLE CHROMIUM AND ITS ALLOYS. Earl T.



Hayes. Mar. 1952. 62p. Contract AF33-038-1084-E. (WADC-TR-52-54)

- 1102  
Cornell Aeronautical Labs.  
DEVELOPMENT OF LOW ALLOY Ti-B STEELS FOR HIGH TEMPERATURE SERVICE APPLICATIONS. Apr. 1952. 78p. Contract W33-038-ac-21094. (WADC-TR-52-77)

- 1103  
Armour Research Foundation  
STRUCTURAL CHANGES OF COMMERCIAL TITANIUM AND TITANIUM-BASE ALLOYS ON HEAT TREATMENT. William Rostoker, Donald J. McPherson, and Max Hansen. Feb. 1953. 103p. Contract AF33-(038)-16347. (WADC-TR-53-62)

Work primarily directed toward the establishment of correlations between heat treatment, microstructure, and mechanical properties is summarized for two types of potentially heat-treatable alloys characterized by the Mo-Ti and Ti-Cr phase diagrams. Limited studies have been devoted to the effects of  $O_2$  on transformation rates and microstructural characteristics, on the conditions for developing anomalously hard  $\beta$  in Ti-Mo alloys, and on correlations of forming end-quench hardenability curves for alloys of Ti-Mo. (auth)

- 1104  
Carnegie Inst. of Tech.  
THE EFFECTS OF RANGE OF STRESS AND PRESTRAIN ON NOTCHED SPECIMENS OF TITANIUM AND ITS ALLOYS. J. P. Romualdi and E. D'Appolonia. Oct. 1953. 44p. Contract DA-36-061-ORD-259. (WAL-401/68-31)

The effect of the theoretical stress concentration factor  $K_T$  on the notch sensitivity for different testing conditions was determined by conducting tests on notched and unnotched specimens at different speeds and under isothermal and nonisothermal conditions. A study of the effect of internal heating on the fatigue life of Ti was made from continuous records of temperature and deflection of rotating beam fatigue specimens tested at different speeds and under isothermal and nonisothermal conditions. Complete reversal fatigue tests were conducted on notched and unnotched specimens prestrained in tension 0.4, 4.0, and 10.0%. Range of stress fatigue tests were conducted on notched and unnotched specimens at stress ratios of -1.0, -0.5, and 0.0. The theoretical stress concentrations of the specimens tested were 1.0, 1.78, and 3.48. (auth)

- 1105  
New York Univ. Coll. of Engineering  
TITANIUM-RICH TERNARY ALLOYS OF TITANIUM WITH CARBON AND NITROGEN, CARBON AND OXYGEN, AND NITROGEN AND OXYGEN. SUMMARY REPORT. L. Stone and H. Margolin. Apr. 15, 1953. 67p. Contract DA-30-069-ORD-208. (WAL-401/85-21)

The Ti-C-N and Ti-C-O systems were studied in the temperature range from 500 to 1400°C and in the composition range up to 2% C and 5% N or O. The Ti-N-O system was studied in the temperature range from 900 to 1400°C with alloys containing up to 6% total alloying addition. Limited mechanical-property and melting-point data were obtained for all three systems. Isothermal and vertical sections are presented for all three systems in the temperature ranges investigated. In over-all characteristics, the Ti-C-N and Ti-C-O phase diagrams are very similar, with a ternary  $\alpha$  plus  $\beta$  plus carbide phase field dominating the diagram in the temperature interval from 1000 to 1400°C. The Ti-N-O system is characterized by  $\alpha$ ,  $\alpha$  plus  $\beta$  and  $\beta$  phase fields, all of which expand to higher alloying contents with increasing temperature. (auth)

- 1106  
Battelle Memorial Inst.  
THE WELDING CHARACTERISTICS OF SELECTED

TITANIUM ALLOYS. INTERIM TECHNICAL REPORT. G. E. Faulkner, G. B. Grable, and C. B. Voldrich. July 31, 1953. 67p. Contract DA-33-019-ORD-231. (WAL-401/97-27)

A study was made of the effects of V and Al alloying elements on welded joints in Ti, and of the welding characteristics of selected experimental Ti alloys. Several series of binary Ti alloys containing V or Al and ternary Ti alloys containing Mn and Al were arc cast and fabricated to plate for welding tests. The tensile properties of the base metals were determined. Welds were made in  $\frac{1}{4}$ - and  $\frac{1}{4}$ -in.-thick plates of these alloys and were tested for bend ductility and notch toughness. Hardness surveys and metallographic examinations of the welded joints also were made. The V alloy additions affected the base-metal and weld-joint properties of Ti about the same as the other  $\beta$ -stabilizing elements, Fe, Mn, Cr, and Mo. The tensile strength of the alloys increased with increasing alloy content, and their bend ductility was lowered slightly. The bend ductility of the welded joints in the alloys decreased rapidly with increasing alloy content and was very low in the 10% alloy. An  $\alpha$ - $\beta$  heat treatment improved the bend ductility of the welded joints, especially in the 5 and 10% alloys. The notch toughness of the weld metals followed a trend similar to that shown by the weld-joint bend ductility. (auth)

- 1107  
Rensselaer Polytechnic Inst.  
CHROMIUM ELECTROPLATING. FINAL TECHNICAL REPORT. Arthur A. Burr, Donald G. Rogers, Robert E. Moore, Peter Lillys, and Alfred Taboada. [1950?]. 163p. Contracts W-30-115-ord-4363 and DA-30-115-ord-2. (WAL-691.1/30-38)

A study of the fundamental principles of Cr deposition and an evaluation of conditions existing in Cr plating baths from the standpoint of thermodynamic and reaction-rate theory are presented. (auth)

- 1108  
ELECTROLYTIC HEATING AS A MEANS OF IMPROVEMENT OF DRAWING PROCESSES. S. I. Gubkin and V. S. Muras. Translated from *Doklady Akad. Nauk S.S.S.R.* 91, 803-6(1953). 3p. (NSF-tr-142)

The process of softening a metal in an electrolyte results in structural and mechanical changes in the metal which increases the drawing capacity. (J.E.D.)

- 1109  
MELTING TEMPERATURES OF TIN AND LEAD AT PRESSURES REACHING 34,000 kg/cm<sup>2</sup>. V. P. Butuzov and M. G. Gonikberg. Translated from *Doklady Akad. Nauk S.S.S.R.* 91, 1083-4(1953). 2p. (NSF-tr-144)

The melting point of Sn under various pressures ranges from 232°C at 1 kg/cm<sup>2</sup> to 3.5°C at 33,000 kg/cm<sup>2</sup>, whereas for Pb it ranges from 327°C at 1 kg/cm<sup>2</sup> to 527°C at 33,000 kg/cm<sup>2</sup>. These data show that the melting points of the metals rise with increase in pressure and that this rise is more rapid in the case of Pb. Further measurements show that the maximum melting temperature of Pb is 532°C at 34,000 kg/cm<sup>2</sup>. (J.A.G.)

- 1110  
TEMPERING OF Al-Ag ALLOYS IN THIN LAYERS. A. Winkelmann and H. Raether. *Naturwissenschaften* 40, 526 (1953). Oct. (In German)

The tempering of Al-Ag alloys was studied by means of electron diffraction. At room temperature there is a cubic  $\delta$  phase and a hexagonal  $\gamma$  phase. The  $\gamma$  phase disappears at 400 to 500°C. After cooling from this temperature, the cubic  $\delta$  phase is found. After continued tempering at 150°, the first indication of a separating hexagonal  $\gamma$  phase,  $Ag_2Al$ , appears. The  $\gamma$  phase originates by a translation of the (111) plane and reaches its greatest sharpness after 36



days. An electron diffraction pattern of a single crystal of the alloy is shown. (J.S.R.)

1111

GAS CONTENT AND ELECTROLYTIC ETCHING BEHAVIOUR OF ALUMINIUM. F. J. Burger and V. F. G. Tull. *Nature* 172, 729-30(1953). Oct. 17.

Rolled-foil samples of nominal purity grade Al (99.8% Al), when given identical electrolytic etching treatment in a 0.2N NaCl solution, displayed different patterns of attack. In some cases the attack was widespread, whereas in others it was strongly localized with large parts of the surface remaining unattacked. Cleaning treatments before the etch failed to alter the general picture, and no correlation between metallic impurities and the etching behavior could be found. However, a strong correlation was found between blistering which occurred upon heating to 600°C for 1 hr or greater and the localized etching and pitting behavior. It was further established that the localized attack was not the result of linking up of cavities already in existence. Since it is known that blistering in heat-treated Al is due to  $H_2$ , it is suggested that the etching behavior can also be correlated with the  $H_2$  content. (L.M.T.)

1112

COMPARATIVE STUDY OF THE MECHANISM OF OXIDATION OF THE BINARY ALLOYS IRON-CHROMIUM, NICKEL-CHROMIUM, AND NICKEL-ALUMINUM. Jean Moreau and Jacques Bénard. *Compt. rend.* 237, 1417-20 (1953) Nov. 30. (In French)

After oxidation, the binary alloys Fe-Cr, Ni-Cr, and Ni-Al have three distinct regions. Next to the metallic phase there is a metal-metal oxide mixed level. In the next level there is found  $FeCr_2O_4$ ,  $NiCr_2O_4$ , or  $NiAl_2O_4$ , with the Cr and Al being the most easily oxidized. On the surface is the pure oxide of the base metal. (J.S.R.)

## PHYSICS

1113

Los Alamos Scientific Lab.

DIAMETER EFFECT I. J. G. Kirkwood and William W. Wood. [Oct. 26, 1953] Dec. Nov. 16, 1953. 25p. Contract W-7405-eng-36. (AECU-3601)

The detonation front in a cylindrical body of explosive under steady-state conditions is considered. The von Neumann model of the reaction zone is presupposed, and the leading shock front is assumed to be spherical with a radius of curvature large in comparison to the diameter of the cylinder. It is necessary to consider the over-all chemical kinetics of the explosive decomposition, and it is assumed that it may be represented in terms of a single reaction. The result is a relation between the detonation velocity and the radius of curvature of the shock front. (auth)

1114

Laboratory for Nuclear Science, Mass. Inst. of Tech. PROGRESS REPORT NO. 30 [FOR] MAY 31, 1953 TO AUGUST 31, 1953. Aug. 31, 1953. 82p. Contract AT(30-1)-905. (AECU-2740)

Separate abstracts have been prepared for four sections of this report. (For preceding period see AECU-2494.) (K.S.)

1115

Atomic Energy Research Establishment, Harwell, Berks (England)  
SYMPOSIUM ON "UTILIZATION OF RADIATION FROM

FISSION PRODUCTS" HELD AT HARWELL ON FEBRUARY 23 AND 24, 1953. G. N. Walton and J. Wright, eds. June 1953. 165p. (AERE-C/R-1231)

A symposium on the utilization of radiations from fission products was held at Harwell in February 1953. Papers presented, an account of the discussions which took place, a bibliography of unclassified reports issued between 1945 and 1953 on fission product utilization, and a table of units and conversion factors are included in this report. Topics discussed included: the use of  $\gamma$  radiation from reactor fuel rods; the use of radiation from fission product wastes; the specific activity of separated fission products from reactor fuels; the separation of long-lived fission products; the technical feasibility of the use of fission products; the economic feasibility of the use of fission products; the preservation of food; the sterilization of pharmaceutical products; high-energy radiation and long-chain polymers; the effects of ionizing radiation on organic high polymers; the uses of radiation in medicine; methods of mounting separated fission products safely for industrial and medical use; and  $Cs^{137}$  and its use. (C.H.)

1116

Federal Telecommunication Labs., Inc.  
HEAT-RESISTANT THERMOSETTING MOLDING MATERIALS. QUARTERLY DEVELOPMENT REPORT NO. 9. S. Kaganoff. May 1953. 28p. Contract DA36-039-sc-5483. (FTL-5483/QDR-9; AD-12793)

The significance of variations of the quality of triethanolamine when used as catalyst is reported. Data are presented to show that the different grades of triethanolamine available on the market possess different catalytic activity. The conclusions were corroborated by the behavior of the material in molding. New information was developed concerning the moldability of the experimental molding materials on plant semiautomatic presses employing compression and transfer molding. Extensive molding tests aimed at selection of short molding cycles are reported. The experimental data on compounding, molding, and testing are tabulated. (auth)

\*1117

Ames Lab.

SOME STUDIES ON THE DIFFUSION OF SODIUM IN SODIUM TUNGSTEN BRONZE. John F. Smith, G. C. Danielson, and H. A. Wilhelm. Mar. 1953. 51p. Contract W-7405-eng-82. (ISC-341)

A study of the process of Na diffusion in single crystals of the metallic Na-W bronze was made. Concentration gradients were established by effusion of Na from single crystals into a vacuum. The concentration gradients were measured by means of an x-ray determination of a precision lattice constant, Vegard's law relationship being used to evaluate the Na concentration. Advantage was taken of the high absorption of Cu x radiation in the Na-W bronze in order to measure the lattice parameter of an exposed crystal surface. The diffusivity was evaluated by a method which has not been previously suggested or used. This method was based upon Fick's first law rather than his second. The data obtained from a series of crystals held at constant temperature for varying times gave a family of curves showing the concentration as a function of depth with time as a parameter. From these curves the mass of Na transferred through a plane parallel to the surface and at any particular depth was plotted as a function of time. The slope of this curve divided by the concentration gradient, both evaluated at the same time and depth, was the diffusivity for the corresponding concentration. (auth)

1118

Knolls Atomic Power Lab.  
SOLUTION OF BEAM PROBLEMS BY BIHARMONIC



**POLYNOMIALS WHICH SEPARATE THE EFFECTS OF BOUNDARY SHEARS AND BOUNDARY NORMAL STRESSES.**

G. Horvay, R. T. Gray, and J. S. Born. June 12, 1953. 95p. Contract W-31-109-Eng-52. (KAPL-953)

Bi-harmonic polynomials are given which separate the effect of boundary shear stresses and boundary normal stresses. As a result a convenient method is provided for solution of certain beam problems in which Fourier expansions (frequently of unsatisfactory convergence) were formerly used. The method is compared with the still simpler, but approximate, method of self-equilibrating polynomials, and it is found that the latter is adequate for most engineering problems. (auth)

1119

Naval Research Lab.

**THERMAL AND RELATED PHYSICAL PROPERTIES OF MOLTEN MATERIALS. PROGRESS REPORT NO. 7 [FOR] AUGUST 1 TO OCTOBER 31, 1953.** D. D. Williams, C. T. Ewing, and B. E. Walker. Nov. 12, 1953. 13p. (NRL-Memo-230)

This report covers work on three phases of the measurements to be performed on this contract. They are the reactions between Ni and NaOH in a study of container materials for the hydroxide and the thermal conductivity and the heat capacity of  $\text{MoSi}_2$ . Preliminary values on the lower temperature scales are reported for the conductivity and heat capacity. Measurements are continuing, and values will be reported to  $900^\circ\text{C}$ . (For preceding period see NRL-Memo-197.) (auth)

1120

Radiation Lab., Univ. of Calif., Livermore

**LUNAR HEIGHT CHANGES IN THE E-LAYER.** M. H. Johnson. Oct. 1953. 10p. Contract W-7405-eng-48. (UCRL-4203)

The height changes produced by vertical electronic diffusion in the presence of negative ions are examined in some detail. Application of the results to the E layer shows that a previous qualitative discussion remains valid. (auth)

1121

**LUMINESCENCE OF THE ELECTRONIC SEMICONDUCTOR — ZINC OXIDE.** F. I. Vergunas and G. A. Kononov. Translated by J. I. Pankove from *Zhur. Eksptl' i Teoret. Fiz.* 23, 712-19(1952). 17p. (AEC-tr-1636)

The hypothesis is offered that Zn atoms are responsible only for the conductivity of ZnO, and  $\text{Zn}^+$  ions appear as centers of luminescence. The phosphorescence which is observed in ZnO at low temperature is explained by the activation for the process of recombination of free electrons with ionized centers. (tr-auth)

1122

**ON THE POSSIBILITY OF USING RADIATIONS OF STABLE CADMIUM ISOTOPES OF EVEN MASS NUMBER FOR THE REPRODUCTION OF THE UNIT OF LENGTH.** N. R. Batarchukova, A. I. Kartashev, and M. F. Romanova. Translated from *Doklady Akad. Nauk S.S.S.R.* 90, 153-6 (1953). 4p. (NSF-tr-107)

An investigation of the reproducibility of the wavelengths of the red lines emitted by the stable, even isotopes  $\text{Cd}^{112}$ ,  $\text{Cd}^{114}$ , and  $\text{Cd}^{116}$  is presented. It is concluded that the spectrum of the even Cd isotopes with their widely spaced and easily resolvable lines is convenient for practical purposes in determining the order of interference by the method of coincidence of the fractional parts. Therefore, the source of light that was investigated, with its single Cd lines, can be used successfully for interferometric measurements of length. (J.A.G.)

1123

**PHOTO-IONIZATION OF COMPLEX ATOMS.** L. A.

Vainshtein and B. M. Yavorsky. Translated from *Doklady*

*Akad. Nauk S.S.S.R.* 89, 813-16(1953). 4p. (NSF-tr-112)

In a preceding paper (*Doklady Akad. Nauk S.S.S.R.* 87, 919(1952)) a method was proposed for computing the transition probabilities for valence electrons between discrete atomic levels. In the present paper the transition probabilities to levels in the continuum are computed. The effective photoionization cross section obtained is compared with previous ones obtained by the Hartree-Fock method. (L.M.T.)

1124

**KINETICS OF THE DESTRUCTION OF SUPERCONDUCTIVITY BY AN ALTERNATING FIELD ( $\omega \lesssim 10^6 \text{ sec}^{-1}$ ).** I. M. Lifshits. Translated from *Doklady Akad. Nauk S.S.S.R.* 90, 363-6(1953). 5p. (NSF-tr-114)

A discussion is presented on the destruction of superconductivity by a high-frequency field. The magnetic field applied to the sample is directed along its surface. It is assumed for simplicity that the superconductor occupies the half-space bound by the plane  $z = 0$  (the  $z$ -axis is directed into the superconductor). By limiting the frequencies to  $\sim 10^6 \text{ sec}^{-1}$ , it is possible to use in the layer of the normal phase the usual relation between the electric field and the current:  $j = \sigma E$ , where  $\sigma$  is the normal conductivity. Equations are given for computing the normal-layer boundary conditions, relaxing phenomena, dimensionless coordinates, critical field when its increase is small, allowance for relaxation effects at the boundary between phases, and motion of the boundary. (J.A.G.)

1125

**THE MODULATION METHOD OF MEASURING DISPERSION OF ULTRASONIC RADIATION.** V. A. Zverev. Translated from *Doklady Akad. Nauk S.S.S.R.* 91, 791-4(1953). 4p. (NSF-tr-133)

A method is developed for measuring the dispersion quantity  $d^2k/d\omega^2$  of an ultrasonic wave which is based upon phenomena associated with the propagation of a modulated wave, periodic in space and time. The dispersion measurement is reduced to a problem of evaluating a ratio of constants associated with the periodic wave. (K.S.)

1126

**STUDY OF PHASE TRANSFORMATIONS BY INTERNAL FRICTION METHOD.** K. M. Rozin and B. N. Finkel'shtein. Translated from *Doklady Akad. Nauk S.S.S.R.* 91, 811-12 (1953). 3p. (NSF-tr-143)

Internal friction can be used in studying not only the result of phase transformation but also the kinetics of the process. A comparison of the measurements of the internal friction and the electric resistance of a sample of carbide-forming austenite steel quenched at  $800^\circ$  showed that in the course of 2.5 hr the electric resistance decreased by 1.3%, whereas the internal friction increased by 180%. (J.E.D.)

1127

**CLASSICAL CONSIDERATIONS ON THE ABNORMAL PROPERTIES OF HELIUM-4.** S. F. B. Tyabji. *Nature* 172, 849-50(1953). Nov. 7.

In work on the quantum theory of liquids in the Lagrange variables it was found that many of the abnormal qualities of  $\text{He}^4$  are explained by classical theory alone, on the basis of the following assumptions: (1) the internal energy can be

expressed in the classical form  $W = \int \frac{p}{\rho^2} dp$ , the functional

relationship between  $p$  and  $\rho$  to be determined by experiment; (2) at low temperatures the heat energy consists mainly of longitudinal waves, "phonons", of wavelengths long compared to the molecular distances; and (3) the viscosity consists of the change in momentum in one layer of a laminar flow by reason of different-velocity particles from an adjacent layer passing into the first layer as a result of thermal agitation. A discussion of the observed abnormal



properties on the basis of this modified classical theory is presented. (L.M.T.)

## AEROSOLS

\*1128

Oak Ridge National Lab.

THE DIFFUSION BATTERY METHOD FOR AEROSOL PARTICLE SIZE DETERMINATION. Jess W. Thomas. Issued Jan. 5, 1954. 68p. Contract W-7405-eng-26. (ORNL-1648)

Two parallel plate diffusion batteries were made and used for particle size determination in the 0.1- $\mu$  radius range. The aerosol particle size as determined by the batteries was compared with the size as determined by a standard light scattering method. Results agreed to within 30%. Circular tube batteries were made and used to check the applicability of the method to diffusion of particles as small as gas molecules. The diffusion coefficients of gas molecules obtained by this method agreed well with the literature values. It was concluded that the diffusion battery is a valuable instrument for study of the particle size of aerosols from atomic sizes up to particle radii of about 0.5  $\mu$ . Two batteries, with graphs of operating parameters, are now available for use in filter efficiency studies. (auth)

1129

THE MECHANISM OF THE ELECTRIFICATION OF ARTIFICIAL AEROSOLS (SMOKES). A. M. Furman. Translated from Zhur. Tekh. Fiz. 17, 111-14(1947). 6p. (AEC-tr-685)

A mechanism is presented for the electrification of artificial aerosols, based on the assumption that the charging of an aero-dispersed system formed at high temperatures is connected with the phenomenon of thermionic emission. (C.H.)

## COSMIC RADIATION

1130

DETERMINATION OF THE NUMBER OF SLOW  $\pi$ - AND  $\mu$ -MESONS IN COSMIC RAYS AT DIFFERENT HEIGHTS.

Kh. P. Babayan, I. I. Zinger, and N. A. Marutyan. Doklady Akad. Nauk S.S.S.R. 92, 263-4(1953) Sept. 11. (In Russian)

By means of photographic plates, an attempt was made to measure the ratio  $n_\pi/n_\mu$  of mesons with energy approximately 12 Mev. The measurements were made at heights of 960, 1950, 3250, and 3980 m above sea level. The ratio  $n_\pi/n_\mu$  at 960 to 1950 m was  $0.34 \pm 0.15$ , at 3250 m it was  $0.57 \pm 0.11$ , and at 3980 m it was  $0.69 \pm 0.29$ . (J.S.R.)

1131

MESONS AND HEAVY UNSTABLE PARTICLES IN COSMIC RAYS. Louis Leprince-Ringuet. Ann. Rev. Nuclear Sci. 3, 39-66(1953).

The important features of heavy mesons and other fundamental particles experimentally observed in cosmic rays are summarized. Specific discussions are presented regarding the observation and decay of  $\tau$  mesons, K-type mesons ( $\kappa$  and  $\chi$ ), S particles, and charged and neutral V particles. The principal experimental facts submitted at the International Meeting on Cosmic Radiation held in Bagnères-de-Bigorre, France, in July 1953 are presented, including a nomenclature scheme suggested by several of the participants. 79 references. (L.M.T.)

1132

POSSIBLE EXAMPLE OF A NEW MODE OF DISINTEGRATION OF THE NEUTRAL  $\pi$ -MESON. S. Goldsack, M. Schönberg and G. Vanderhaeghe. Nuovo cimento (9) 10, 1480-1(1953). Oct. 1. (In English)

An event found in a nuclear emulsion exposed at 2000 m seems to be a  $\pi$ - $\mu$  decay accompanied by the emission of an electron. The suggestion is offered that the event is caused by a charged  $\pi$  meson striking a nucleus with charge exchange and becoming a neutral  $\pi$  meson, which disintegrates

in flight into an electron and a  $\mu$  meson. The possibility that the event is an accidental coincidence is acknowledged. (J.S.R.)

1133

CHREE ANALYSIS OF PRESSURE-TEMPERATURE-CORRECTED COSMIC-RAY BURST FREQUENCIES. J. W. Broxon. Nuovo cimento (9) 10, 1434-40(1953). Oct. 1. (In English)

By Chree's method of superposed epochs, recurrence phenomena and relations to other variables were found in the frequency of occurrence of small cosmic-ray bursts in a heavily shielded chamber at 1,646 m altitude and 49°N geomagnetic latitude. The recurrences at intervals of about 27 days were found to persist after correction of the burst data for variations in barometric pressure and atmospheric temperature by application of the very large coefficients,  $-4.58 \pm 0.22\%/mm$  Hg and  $-2.53 \pm 0.10\%/^{\circ}C$ , determined recently. A defense of the Chree method of analysis is included. (auth)

## INSTRUMENTS

1134

Los Alamos Scientific Lab.

OPERATING EXPERIENCE WITH THE LOS ALAMOS 701. Willard G. Bouricius. [1953]. 7p. Contract W-7505-eng-36. (AECU-2760)

Routine operation and personnel training procedures for the Los Alamos 701 calculator are briefly discussed. (J.A.G.)

1135

Atomic Energy Research Establishment, Harwell, Berks (England)

A SCALING UNIT EMPLOYING MULTI-ELECTRODE COLD CATHODE TUBES. K. Kandiah. Feb. 16, 1953. 31p. (AERE-EL/R-1112)

A complete scaling unit for counting regular or random pulses is described. The unit employs cold-cathode scaling tubes and trigger tubes in the main counting circuits. Various methods of driving cold-cathode scaling tubes are fully described. A novel method of driving the CV2271 scaling tubes is used in which the amplitudes and durations of the pulses to all stages in a cascade of these tubes is controlled directly by a common pulse generator, and cold-cathode trigger tubes are used as gating elements between the stages. A new type of pulse-amplitude discriminator of high sensitivity is used at the input of the scaling unit. A simple system of marginal testing of the complete equipment is incorporated in order to obtain early indication of deterioration of tube characteristics. (auth)

1136

Atomic Energy Research Establishment, Harwell, Berks (England)

A SIMPLE INVERTING TRANSFORMER FOR MILLI-MICROSECOND PULSES. I. A. D. Lewis and H. C. Whitby. Nov. 26, 1951. 18p. (AERE-G/R-751)

1137

Commissariat à l'Énergie Atomique (France)  
ALIMENTATIONS REGULEES POUR SEPARATEUR D'ISOTOPES. [REGULATED POWER SUPPLY FOR ISOTOPE SEPARATOR.] A. Lavaitte and J. Pottier. Oct. 1953. 34p. (CEA-163)

The regulated power supply is comprised of two parts, a voltage regulator and a current regulator. For the voltage regulator, vacuum tubes are used because of the very large and sharp fluctuations of the ion beam. The current regulator utilizes a generator because its inertia augments the stability and self-suppression of the harmonics in the circuit. The specifications and operating principles of the two regulators are discussed. Schematics are given. (J.S.R.)



1138

National Research Council of Canada. Radio and Electrical Engineering Div.  
THE EMISSION LIFE OF OXIDE CATHODE TUBES. P. A. Redhead and L. R. McNarry. July 1952. 28p. (ERA-229; NRC-2783)

1139

Hanford Works  
A STUDY OF PHOTOGRAPHIC EMULSION CALIBRATION TECHNIQUES. John A. Parodi and W. G. Burch, Jr. July 27, 1953. 38p. Contract W-31-109-Eng-52. (HW-28803)

A study of various methods of photographic-emulsion calibration is presented. The methods investigated are the multiple-step filter, multiple-step rotating sector, two-step filter, two-step sector, and homologous-line-pair procedures. The technique based upon the invariant intensity ratio of a homologous pair of lines (Fe 3217.3 Å and Fe 3215.9 Å) is shown to give the most precise and reproducible results. The precision of measuring the intensity ratios of given lines from a number of characteristic curves prepared by the homologous pair method is less than  $\pm 1\%$  unless the intensity ratios differ greatly from unity. Various kinds of slit illumination are considered, and it is concluded that focusing the source on the collimator with a simple spherical condenser placed as close to the slit as possible is the most satisfactory method for an astigmatic spectrograph. It is shown that reciprocity failure does not contribute to a change of contrast of the emulsion over a 15- or 20-fold range of intensities when exposures are in the normal analytical range of a few seconds to a few minutes. (auth)

1140

Chalk River Project (Canada)  
ELECTRONICS BRANCH PROGRESS REPORT [FOR] JULY 1 TO SEPTEMBER 30, 1953. J. Hardwick. 20p. (PR-P-19-E)

A portable contamination meter has been constructed, using a G-M tube and cold-cathode tubes exclusively. Clockwork choppers are used to provide pulsating d-c, and the use of eight Arctic cells is expected to provide an operating life of 200 hr. Tube-life tests on the effect of plate voltage on the emission of thermionic tubes indicate no significant effects at 500 hr of operation. A tube-life prediction test, requiring 24 hr or less to perform, is discussed. Circuit design factors affected by the characteristics of point or junction transistors are outlined with emphasis on circuits for nucleonic applications. Some preliminary results on the testing of Veeder-Root type 1059 electromechanical registers are presented. (For preceding period see PR-P-18-E.) (K. S.)

1141

Radiophysics Lab., Univ. Grounds, Sydney (Australia)  
AUTOMATIC COMPUTATION. PART 3. PROGRAMMES FOR THE Mk. 1 COMPUTER: PART 1. T. Pearcey. Aug. 1953. 70p. (RPR-122)

The construction of typical short routines suited to the design of the computer is discussed. In particular, examples of programs of the type called subroutines are given for the simpler arithmetical functions only. (J.A.G.)

1142

PULSE-HEIGHT ANALYZER. J. W. Thomas, V. V. Verbinski, and W. E. Stephens. *Rev. Sci. Instr.* **24**, 1017-20(1953). Nov.

A pulse-height analyzer using conversion of pulse amplitude to time is described. It has an accuracy, resolution, linearity, and stability better than one %. It can be exposed to pulse rates of several thousand per second and records on tape up to 50 pulses per sec. It is equivalent to a 250-channel discriminator of relative simplicity. (auth)

## ISOTOPES

1143

Joint Establishment for Nuclear Energy Research (Norway)  
PRODUCTION OF  $I^{131}$  FOR MEDICAL USE FROM TELLURIUM IRRADIATED IN THE URANIUM PILE AT KJELLER. Kjell Taugböll and Ulf Blix. 1953. 7p. (JENER-18)

Methods are described for the production of  $I^{131}$  having a high specific activity by means of the pile irradiation of Te. The apparatus used in the chemical separation of  $I^{131}$  is described. (C.H.)

1144

A COMPARISON OF LEAD ISOTOPE ANALYSIS TECHNIQUES. G. H. Palmer and K. L. Aitken. *Nature* **172**, 860(1953). Nov. 7.

Results are presented of measurements of the relative abundances of the isotopes of Pb as analyzed by a  $180^\circ$  Nier-type spectrometer at the Univ. of Toronto and a  $60^\circ$  Nier-type instrument at AERE, Harwell, England. In one analysis  $Pb(CH_3)_4$  was used in the ion source, while  $PbCl_2$  or  $PbI_2$  was used in the other. Results for the two methods and the two spectrometers agree well, with a slight discrepancy occurring in the case of  $Pb^{204}$ . (L.M.T.)

## ISOTOPE SEPARATION

1145

ENRICHMENT OF THE ISOTOPIC MOLECULE IN THE DIRECT GLOW DISCHARGE. II. THE MULTIPLICATION PROCESS. ENRICHMENT OF HEAVY HYDROGEN. H. D. Beckey, W. E. Groth, and K. H. Welge. *Z. Naturforsch.* **a8**, 556-62(1953). Sept. (In German)

The enrichment of  $D_2$  in a  $H_2$ - $D_2$  mixture at the cathode of a d-c glow discharge was investigated by its dependence on the length and diameter of the discharge tube, current density, gas pressure, temperature, time, and condition of the tube walls. The results are explained by a multiplication theory of the primary process in the dissociation of the molecule and recombination of the atom during the discharge of the axial current. Agreement between the measured results and theoretical considerations is established. (tr-auth)

## MASS SPECTROGRAPHY

1146

A MASS SPECTROMETER FOR HIGH PRECISION ISOTOPE RATIO DETERMINATIONS. R. K. Wanless and H. G. Thode. *J. Sci. Instr.* **30**, 395-8(1953). Nov.

A conventional  $90^\circ$  mass spectrometer has been modified to permit the simultaneous collection and measurement, by means of a null method, of the ion currents due to the isotopic species of  $SO_2$  at masses 64 and 66. The design of a magnetic valve system to facilitate the rapid change from one sample to the other is described, as well as an improved ion source and collector assembly. By this method analyses may be carried out more rapidly and it has been found that the results are reproducible to  $\pm 0.02\%$  from day to day, which compares with 0.1% precision obtained with single collection methods. The analytical procedure is outlined. (auth)

## MATHEMATICS

1147

Los Alamos Scientific Lab.  
PROOF OF VALIDITY ON MONTE CARLO METHOD FOR CANONICAL AVERAGING. Marshall Rosenbluth. [1953] 7p. [Contract W-7405-Eng-36] (AECU-2773)

In a previous article (*J. Chem. Phys.* **21**, 1087(1953)) a prescription was given for moving from point to point in the configuration space of a system in such a way that averaging over many moves is equivalent to a canonical



average over configuration space. This prescription is suitable for electronic machine calculations and provides the basis for calculations described elsewhere. The purpose of this paper is to present a more rigorous proof of the method. (auth)

1148

RENORMALIZATION OF THE TAMM-DANCOFF EQUATION. H. Lehmann. *Z. Naturforsch.* **a8**, 579-80(1953). Sept. (In German)

It is shown that by application of the Tamm-Dancoff method divergent expressions, such as the  $S$  matrix, will arise which can not be interpreted as renormalization terms. The divergent terms are consequent product of this method by extensive invariant formalization in the procedure. (J.S.R.)

# MEASURING INSTRUMENTS AND TECHNIQUES

1149

Brookhaven National Lab.

THE YIELD OF OXIDATION OF FERROUS SULFATE IN ACID SOLUTION BY HIGH ENERGY CATHODE RAYS.

Jerome Saldick and Augustine O. Allen. [1953]. 17p. (BNL-1629)

An absolute determination of the yield of the  $\text{FeSO}_4$  radiation dosimeter has been made by delivering to the solution a measured charge of cathode rays at known energies of 1 or 2 Mev. Appropriate small corrections have been made for backscattering, window absorption, and bremsstrahlung. The result,  $G = 15.6 \pm 0.5$ , is in complete agreement with Hochanadel's calorimetric determination of the yield but disagrees by 30% with the best determinations by the standard cavity ion chamber comparison method. (auth)

1150

Commissariat à l'Énergie Atomique (France)

SPECTROGRAPHIE  $\alpha$  PAR LA METHODE DE LA CHAMBRE D'IONISATION A GRILLE—APPLICATIONS A L'URANIUM. [ALPHA SPECTROGRAPHY BY THE METHOD OF THE GRID-TYPE IONIZATION CHAMBER. APPLICATIONS TO URANIUM.] G. J. Sayag. Jan. 1953. 40p. (CEA-161)

The design of an ionization chamber and associated electronic circuitry accommodating 9 channels is described. Data on the measurement of the  $\alpha$  spectra from  $\text{U}^{234}$ ,  $\text{U}^{235}$ , and  $\text{U}^{238}$  were obtained with the device. (K.S.)

1151

Commissariat à l'Énergie Atomique (France)

MESURE DE L'EFFICACITÉ D'UN LONG COMPTEUR DU TYPE "HANSON" ET UTILISATION DE CE COMPTEUR A L'ÉTUDE DES NEUTRONS RAPIDES SORTANT DE LA PILE DE CHATILLON. [MEASUREMENT OF THE EFFICIENCY OF A LONG HANSON-TYPE COUNTER AND USE OF THIS COUNTER IN THE STUDY OF FAST NEUTRONS FROM THE CHATILLON PILE]. R. Barloutaud. Mar. 1953. 13p. (CEA-180)

An arrangement for efficiently detecting fast neutrons, independent of neutron energy, is described. The absolute value of the efficiency was measured for groups of neutrons of various energies. The method has been applied to the investigation of the energy spectrum of neutrons emerging from the Châtillon pile. (tr-auth)

1152

Commissariat à l'Énergie Atomique (France)

MESURES DE COINCIDENCES AVEC UTILISATION DE DETECTEURS MESURANT L'ENERGIE DES RAYONNEMENTS. (COMPTEURS PROPORTIONNELS ET COMPTEUR A SCINTILLATIONS). [COINCIDENCE MEASUREMENTS WITH THE USE OF DETECTORS MEASURING RADIATION ENERGIES. (PROPORTIONAL COUNTERS AND SCINTILLATION COUNTERS)]. M. Sartory. Oct. 1953. 39p. (CEA-229)

A scintillation counter is described for measuring the  $\gamma$  and K-capture photon coincidences in  $\text{Se}^{76}$ . A  $4\pi$  proportional counter was used for detecting the x-ray coincidences of  $\text{As}^{75}$ . The lower limit of the internal conversion coefficient for the 54-kev transition in  $\text{As}^{75}$  was found to be  $\geq 7$ . (K.S.)

1153

Hanford Works

GEIGER-MUELLER COUNTER TUBE AGE CHARACTERISTICS. J. S. Reddie and W. C. Roesch. Sept. 23, 1953. 33p. Contract W-31-109-Eng-52. (HW-29420)

Three age characteristics of Geiger counters were investigated. The curve of maximum pulse height from a Geiger counter on exposure to a  $\beta$  source was observed as a function of counter voltage after various total counts; in the Geiger region these curves were found to shift fairly regularly to higher voltages as the counter aged. The Geiger threshold voltage was found to vary logarithmically with the counting rate. The change in threshold voltage per factor of ten increase in counting rate, "threshold coefficient", varied linearly with the total number of counts. It was found that the pulse height at a fixed counter voltage varied approximately as a power of the counting rate and that the logarithm of the ratio of the pulse heights corresponding to counting rates differing by a factor of ten, the "amplitude coefficient", varied linearly with the total number of counts. Counters with extra capacitance added to the anode but operated at nearly the same pulse height were found to age more rapidly than when not so loaded. The change in the aging rate could not be explained as due only to the difference in charge per pulse. Counters operated at very high counting rates were found to age less rapidly than those operated at lower counting rates because of the lower average pulse height from the higher counting rate due to deadtime effects. Adjustment of the counter voltage of a mica-window tube to maintain a selected pulse height at a high counting rate insures adequate pulse height at lower counting rates and was found to provide satisfactory control of the counter. (auth)

1154

[Norman Bridge Lab. of Physics, Calif. Inst. of Tech.]

REVISIONS AND ADDITIONAL INFORMATION SUPPLEMENTING THE CONTENTS OF: "AN AXIAL-FOCUSING MAGNETIC BETA-RAY SPECTROMETER OF HIGH LUMINOSITY, RESOLVING POWER AND PRECISION WITH PROTON-RESONANCE-STABILIZED HOMOGENEOUS FIELD (WITHOUT IRON); COMPRISING THE THEORY, DESIGN, CONSTRUCTION AND TESTS OF THE NEW INSTRUMENT." Jesse W. M. Dumond, Louis Bogart, James L. Kohl, David E. Muller, and James R. Wilts. Nov. 20, 1953. 3p. [Contract N6onr-244]. (NP-4261(suppl.))

Since the issuance of the report listed above, additional experience with the instrument has revealed information which should be made available to persons contemplating copying it. Five specific points regarding revisions or corrections for the instrument are discussed. (L.M.T.)

1155

George Washington Univ.

STATISTICAL THEORY OF COINCIDENCE EXPERIMENTS. Z. Bay, H. Kanner, V. P. Henri. Sept. 1953. 38p. Contract Nonr-168(00). (NP-4988)

The consistent use of a general statistical theory makes possible the elimination of ambiguities from the interpretation of coincidence experiments. It is shown that measurements of time delays and disintegration rates can be accomplished to any desired accuracy by use of experimental coincidence curves alone. For the treatment of the time-resolving properties of coincidence equipment, two characteristic time magnitudes are needed, one of which

is a straightforward generalization of the old definition of the resolving time. The two time magnitudes allow the approximate determination of random time lags. The general theory also provides a strict definition of the coincidence efficiency. (auth)

1156

Radiation Lab., Univ. of Calif., Berkeley

FAST-NEUTRON SCINTILLATION SURVEY METER. B. W. Thompson. Oct. 28, 1953. 15p. Contract W-7405-eng-48. (UCRL-2357)

To estimate the radiation damage caused by fast neutrons, a scintillation survey meter was developed. The instrument measures energy flux density making it necessary to know the neutron distribution approximately. It also gives a sizable response at low flux levels, possesses good  $\gamma$  discrimination, and is nondirectional. (auth)

1157

Utah Univ.

A METHOD OF CALIBRATING RADIAC INSTRUMENTS. (DUGWAY PROJECT). Edward R. Campagna. Dec. 21, 1953. 20p. Contract DA-18-CML-4753. (UUT-6)

Methods are presented and resultant curves are given for the calibration of Beckman MX-4 and Tracerlab T-1B ionization chambers and two Keleket pencil dosimeters. (L.M.T.)

1158

IDENTIFICATION OF NEUTRONS USING BORON TRIMETHYL AND AN INVESTIGATION OF THE  $B^{10}(n,\alpha)Li^7$  REACTION. Ulrich Hermann Hauser. Translated by I. A. Warheit from Z. Naturforsch. 7a, 781(1952). 11p. (AEC-tr-1750)

An abstract of this report appears in Nuclear Science Abstracts as NSA 7-1485.

1159

NEUTRON OPTICS. D. J. Hughes. Ann. Rev. Nuclear Sci. 3, 93-118(1953).

High-intensity well collimated beams of thermal neutrons from piles have made it possible to demonstrate and utilize such well known optical properties as diffraction, refraction, reflection, and polarization. A brief consideration is first given to these underlying principles of neutron optics, after which recent progress in the field is reviewed. Both advantages and disadvantages of neutron optics, sometimes being considered as a replacement and sometimes as an adjunct for the conventional tool of x-ray diffraction, are discussed. 160 references. (L.M.T.)

1160

PHOTOGRAPHIC EMULSIONS. Y. Goldschmidt-Clermont. Ann. Rev. Nuclear Sci. 3, 141-70(1953).

In this limited review, only the measurements performed on the tracks themselves are examined. In addition, a discussion of processing techniques is included. Emphasis is centered on the progress in recent years, particularly the use of more sensitive emulsions in great thicknesses for high-energy regions. No attempt is made to present the problems of emulsion manufacture as they affect sensitivity, nor is there a discussion of specific uses of the plates for detection of neutral particles or application to specific fields. 168 references. (L.M.T.)

1161

SPARK COUNTERS. F. Bella and C. Franzinetti. Nuovo cimento (9) 10, 1461-79(1953). Oct. 1. (In English)

An account is given of a series of experiments which was undertaken to investigate the main characteristics of spark counters. The design and construction of the spark counter is described. The aging, efficiency, and possible applications are discussed. (auth)

1162

DETERIORATION OF BORON TRIFLUORIDE COUNTERS DUE TO HIGH COUNTING RATES. Robert K. Soberman,

Serge A. Korff, Stephen S. Friedland, and Henry S. Katzenstein. Rev. Sci. Instr. 24, 1058-60(1953). Nov.

Twenty-two  $BF_3$  counters were run at counting rates of about  $10^8$  cpm in the proportional region until they had all lost their plateaus of voltage vs. counting rate. This occurred in from  $10^8$  to  $10^9$  counts. The pulse heights decreased to the point at which maximum sensitivity of the circuitry failed to record more than  $10^3$  cpm, although many more small pulses could be detected on an oscilloscope. Raising the voltage did not restore the pulse heights. The counters did not recover after inactive periods of up to four months. Gas samples from several of the counters were analyzed on a mass spectrometer. A theory is proposed which would explain the deterioration on the basis of a negative ion sheath which is formed when the  $BF_3$  dissociates. (auth)

1163

GAMMA-RAY ENERGY RESOLUTION WITH NaI-TII SCINTILLATION SPECTROMETERS. C. J. Borkowski and R. L. Clark. Rev. Sci. Instr. 24, 1046-50(1953). Nov.

A method for preparing and mounting NaI-TII crystals for scintillation spectrometers which gives high optical efficiency, stability, and good  $\gamma$ -ray energy resolution is described. Variations in energy resolution of photomultipliers and NaI-TII crystals are shown. Approximately 200-ev electron energy loss in a NaI-TII crystal is required to release a single photoelectron from a photocathode whose efficiency is 60  $\mu$ a per lumen. (auth)

1164

LOW-PRESSURE CLOUD CHAMBER. Robert G. Mills. Rev. Sci. Instr. 24, 1041-5(1953). Nov.

An expansion cloud chamber has been developed which operates at a pressure before the expansion of about 45 mm of Hg. Since evaporation is rapid and the temperature very low during the sensitive time of the chamber, the density of the gas is higher after the expansion than before. The composition of the gas before the expansion is ~40% water vapor and 60% permanent gas. When the chamber is operated with  $O_2$  or A, the stopping power of the gas during the sensitive time is 7.6% that of NTP air. When it is operated with He, the stopping power is 5.7% that of NTP air. (auth)

1165

A SENSITIVE PHOTOMETER USING MODULATED LIGHT AND ITS APPLICATION IN A URANIUM FLUORIMETER. C. D. Florida and C. N. Davey. J. Sci. Instr. 30, 409-12 (1953). Nov.

A photometer with a sensitivity of about  $10^{-10}$  lumens is described. This instrument has been incorporated in a fluorimeter for the determination of very small quantities of U. This fluorimeter is also described, and test results are quoted which show that an average instrument has a sensitivity permitting about  $5 \times 10^{-10}$  g of U to be measured. (auth)

1166

ON MONITORING A GEIGER-COUNTER SPECTROMETER BEAM. E. Gillam and D. G. Cole. J. Sci. Instr. 30, 429-30(1953). Nov.

Tests on three different ways of monitoring a Geiger-counter spectrometer beam with a second Geiger counter show that the most suitable method appears to be a single-window single-beam system, in which an Al foil is placed in the path of the beam and diffracts a fraction of the intensity into the monitoring counter. This system has the advantage of using only one window of the x-ray tube although its variances are not noticeably smaller than a two-window system. It also does not appear to drift over long periods of time. A general difficulty in the monitoring of such beams by this method is discussed. (auth)



1167

A RAPID METHOD OF OBTAINING NUCLEAR MAGNETIC RESONANCE SPECTROGRAMS. K. Taylor. Nature **172**, 722-3(1953). Oct. 17.

A method is briefly described whereby  $H_1$  (the r-f field) is held constant and  $H_0$  (the d-c magnetic field) is swept rapidly over a relatively wide range, providing not only a simple method of demonstrating nuclear resonance effects but also a rapid method for searching for unknown resonances. A large and relatively sudden change in the d-c field was made by short circuiting a resistor in the driving circuit of the electromagnet. The value of the resistor was chosen so that the rate of change of the field (100 to 1000 gauss/sec) was effectively linear over the region being investigated. Three typical spectrograms obtained by the rapid method are presented. (L.M.T.)

1168

A PROPORTIONAL COUNTER USED AS A BETA AND GAMMA SPECTROMETER. G. Bertolini, A. Bisi, and L. Zappa. Nuovo cimento (9) **10**, 1424-33(1953). Oct. 1. (In Italian)

A description is given of a proportional counter, used for the analysis of  $\beta$  and  $\gamma$  spectra. The counter is permanently attached to a purifier which allows the continuous purification of the gas during the measurements. The variation of the resolving power of the spectrometer with energy was studied. It was concluded that, at least up to 50 kev, this resolving power is limited only by the fluctuations in the number of ion pairs released in the gas by the ionizing particle, and by the fluctuations introduced by the statistics of the multiplication process. In an application of the technique, the fluorescence yield of the K shell of argon was measured. The value obtained was  $\omega_K = 0.085_0 \pm 0.002_7$ . (auth)

1169

SOME REMARKS ABOUT THE DISCHARGE MECHANISM IN GEIGER COUNTERS. S. A. Korff. Rev. Sci. Instr. **24**, 1071-2(1953) Nov.

Discussions are presented on the subject of "lags" in Geiger counters by first considering the movement of the electrons from the ionizing event until they reach the high field region and then analyzing the lateral spreading velocity of the discharge in the counter as it spreads from the initial Townsend avalanche down the length of the wire. (L.M.T.)

1170

RADIAC INSTRUMENTATION. Denis Taylor. J. Sci. Instr. **30**, 436-7(1953) Nov.

The author in a previous paper (J. Sci. Instr. **29**, 315 (1952)) gave detailed specifications for various civil defense radiation-monitoring instruments. As a further aid to designers, this note discusses such factors as the rate at which dosage might be received, estimation of the upper limit of  $\gamma$ -dose rate for individual dosimeters, "memory" effects after irradiation, recovery after overdoses of  $\gamma$  radiation, and necessary insulation. (L.M.T.)

## MESONS

1171

Radiation Lab., Univ. of Calif., Berkeley  
CHARACTERISTICS OF THE HIGH-ENERGY NEGATIVE PHOTOPIONS FROM DEUTERIUM (thesis). Kenneth C. Bandtel. July 1953. 64p. Contract W-7405-eng-48. (UCRL-2324)

Negative pions photoproduced from  $D_2$  by the 330-Mev bremsstrahlung of the Berkeley synchrotron have been investigated by observing pion-proton coincidences. A  $(CD_2)_n - (CH_2)_n$  subtraction yields the neutron contribution. The purpose of the investigation is to determine how often

the initial triplet spin state of the deuteron changes to a singlet spin state for the two final identical nucleons, in the reaction  $\gamma + d \rightarrow \pi^- + p + p$ . The energy spectrum produced has been calculated by assuming 1) the spin state always to remain the same and 2) the spin state always to change. The experimental measurements are integral over meson energy from a lower limit upwards and also over the time of flight between the proton and the pion. Thus, when the spectra are folded into the experimental resolution of the equipment and the bremsstrahlung spectrum, they yield a number proportional to the experimental measurement. The ratios of various experimental measurements are compared with the theoretical predicted ratios. Within the limitations of the theory (which uses a nonrelativistic expression for the nucleon energies) and the accuracy of the experimental measurements, the results indicate an interaction intermediate between the two extremes. (auth)

1172

DISINTEGRATION INTO 3  $\pi$ -MESONS AND THE HYPOTHESIS OF ISOTOPIC INVARIANCE. V. B. Berestetskii [Berestetsky]. Translated from Doklady Akad. Nauk S.S.S.R. **92**, 519-21(1953). 3p. (NSF-tr-135)

The ratio of the probability of  $\tau$ -meson decay according to  $\pi^+ + \pi^+ + \pi^-$  and  $\pi^0 + \pi^0 + \pi^+$  schemes is theoretically determined by the construction of a wave function symmetric with respect to interchanges of three particles with unit isotopic spin. The ratio of the probabilities is found to be between 1 and 4. (K.S.)

1173

RADIATIVE CORRECTIONS IN THE DECAY OF  $\mu$ -MESONS. E. M. Lipmanov. Translated from Doklady Akad. Nauk S.S.S.R. **90**, 999-1001(1953). 3p. (NSF-tr-139)

An abstract of this report appears in Nuclear Science Abstracts as NSA 7-5603.

1174

OBSERVATION OF THE STOPPING OF PARTICLES WITH MASSES OF 500 TO 600  $m_e$ . A. Alikhanyan, V. Kirillov-Ugryumov, N. Shostakovich, V. Fedorov, and G. Merzon. Translated from Doklady Akad. Nauk S.S.S.R. **92**, 511-13 (1953). 4p. (NSF-tr-150)

Several examples of the stopping of positive particles in the mass spectrum of 500 to 600  $m_e$  are discussed. The particles were detected in a Wilson cloud chamber containing 8 Cu plates 3 mm thick. For the cases considered, where the particles were stopped in the filters, it was found that stopping was accompanied by an electron-pair emission. A  $\pi^0 + \pi$  decay scheme is suggested, with the electron-pair production associated with the  $\pi^0$  meson. Since  $\pi^+$  stopping is accompanied by only single-electron emission, the results of this investigation indicate a reliable method for distinguishing the  $\pi^+$ , under these experimental conditions of  $\pi$ - $\mu$ -e decay. It is concluded that the lifetime of these particles cannot be much shorter than  $5 \times 10^{-9}$  sec. (K.S.)

1175

NEGATIVE  $\mu$ -MESON CAPTURE IN CARBON. T. N. K. Godfrey. Phys. Rev. **92**, 512(1953). Oct. 15.

The capture of  $\mu^-$  cosmic mesons in C was studied by a scintillation counting technique in order to determine the probability for the end product to be  $B^{12}$  in its ground state. If A is the nuclear capture rate of  $\mu^-$  mesons in C and P is the meson capture reaction resulting in a  $B^{12}$  nucleus in the ground or bound-excited state, then P/A is determined to be  $0.09 \pm 0.05$ . The neutron multiplicity for the capture of  $\mu^-$  mesons in C is yet to be determined. (K.S.)

1176

APPLICABILITY OF THE WEIZSÄCKER-WILLIAMS METHOD TO MESON FIELDS. James McConnell. Proc. Roy. Irish Acad. **A55**, 183-94(1953) July.

Total production cross sections of  $\pi$  mesons are investi-

gated by adapting the Weizsäcker-Williams method to a spectrum of mesons. Nucleon-nucleon collisions are treated by perturbation methods wherein a pseudoscalar meson-nucleon coupling is assumed. For energies greater than 12 bev, it is shown that total production cross sections for a charge-symmetrical theory and a charged-theory proton-proton collision are proportional to  $(\log E)^2/E$ . For a charged theory and a proton-neutron collision, the cross section is proportional to  $\log E/E$ . The coupling constant  $g$  is such that  $g^2/\hbar c \sim 4$  for 3-bev incoming nucleons. (K.S.)

1177

SEMICLASSICAL THEORY OF THE SCATTERING OF  $\pi$ -MESONS BY NUCLEONS. E. Fabri. *Nuovo cimento* (9) 10, 1367-74(1953). Oct. 1. (In Italian)

The scattering of  $\pi$  mesons by nucleons was studied by the natural extension of Pauli's method. As charge is unquantized, agreement with the quantum theory was imposed so that the results may be interpreted. The cross sections obtained agreed within the perturbation limit with those of the quantum theory, but not with the experimental results. (tr-auth)

1178

ON THE POSSIBLE EXISTENCE OF ASSOCIATED KNOCK-ON ELECTRONS. A. W. Wolfendale. *Nuovo cimento* (9) 10, 1493-4(1953). Oct. 1. (In English)

The tentative interpretation of events of a counter-hodoscope experiment in terms of the cross section for the production of electronic secondaries by  $\mu$  mesons (NSA 7-601) is examined. From cloud chamber and counter experiments it is concluded that it is unlikely than any appreciable degree of dependence of production of electron secondaries exists. (J.S.R.)

1179

A K-MESON ISSUING FROM A STAR. M. Baldo and B. Sechi. *Nuovo cimento* (9) 10, 1482-4(1953). Oct. 1. (In Italian.)

A heavy meson issuing from a star was observed in a nuclear emulsion exposed at 27,000 m. The star consists of 16 black streaks, 13 gray streaks, and 4 white streaks. The K meson had a track of 600  $\mu$ , an ionization of  $1.05 \pm 0.05$  v, and a  $p\beta$  value of  $158 \pm 53$  Mev/c. The angular distribution of the black and gray streaks is compared with those from a star of medium energy. (J.S.R.)

1180

CAPTURE OF  $\mu$ -MESONS BY ATOMIC NUCLEI. T. Eguchi and M. Ohta. *Nuovo cimento* (9) 10, 1415-23(1953). Oct. 1. (In English)

The Fermi gas model of the nucleus is used for the calculation of the capture probabilities of negative  $\mu$  mesons by nuclei, taking into account the neutron excess and the motion of the  $\mu$  mesons in the nuclei. In heavy elements the probabilities as functions of the atomic number  $Z$  turn out to be about 60% of the values obtained from Wheeler's  $Z_{\text{eff}}^4$  law. The most probable excitation energies due to the reaction are found less in heavy elements than in lighter ones in contradiction to the experimental results obtained recently. (auth)

## METEOROLOGY

1181

California Univ., Los Angeles

INVESTIGATION OF ATMOSPHERIC DIFFUSION PROCESSES BY MEANS OF EXPERIMENTAL, ANALYTICAL, AND NUMERICAL TECHNIQUES. H. F. Poppendiek and J. E. Vehrencamp. May 1950. 57p. Contract N6-onr-275, T. O. 6. (NP-4995)

1182

Weather Bureau, Oak Ridge, Tenn.

A METEOROLOGICAL SURVEY OF THE OAK RIDGE AREA:

FINAL REPORT [COVERING THE PERIOD] 1948-52. 584p. (ORO-99)

A comprehensive report is presented on the observations and analysis conducted between 1948 and 1952 by the Weather Bureau Office, Oak Ridge, Tennessee. The purpose of the meteorological survey program is outlined, and geographical factors of importance are described. Available climatological records in the vicinity are reviewed. Instruments and techniques used are discussed, and novel or unique instruments are described and illustrated in detail. The findings of the survey with respect to meteorological phenomena are summarized. An attempt is made to apply generalized theory combined with local climatological parameters to the problem of the dispersion of pollutants in the lower atmosphere. (C.H.)

## MOLECULAR PROPERTIES

1183

Institute of Rate Processes, Univ. of Utah

THE WAVE MECHANICAL PROBLEM OF THREE HYDROGEN ATOMS. TECHNICAL REPORT NO. 3. USE OF NUCLEAR ATTRACTION INTEGRAL APPROXIMATIONS IN MOLECULAR QUANTUM MECHANICS. Roland S. Barker and Henry Eyring. Nov. 1, 1953. 6p. Contract DA-04-495-ORD-436. (NP-4984)

Certain approximations for three-center nuclear attraction integrals are examined. Complete sample calculations are made with the approximate integral values for the triatomic activated complex molecule,  $H_3$ . The unit-orbital-charge, covalent-structural approximate calculation (approximate Heitler-London treatment) for this molecule gives a binding energy 7.6 kcal/mole lower than the "actual" integral evaluation. A trial calculation using the same type, but more exact "distance normalized" approximation gave (with a mixed orbital-charge, covalent-structural treatment) a binding energy 5.3 kcal/mole higher than the best previous determination. This trial calculation (using the parametric values  $R = 1.8$ ,  $Z_0 = 1$ ,  $Z_m = 1.08$ ), while the best of several tried, is not likely the best that can be found. However, the binding energy of 72.7 kcal/mole calculated is 26 kcal/mole better than the unit-charge Heitler-London value (53.4 kcal/mole) and 5 kcal/mole better than the Wang-like covalent-bond-plus-ionic-terms determination from a single-orbital-charge variation parameter. (auth)

1184

ON THE DERIVATION OF EQUATIONS FOR EQUILIBRIUM MOLECULAR DISTRIBUTION FUNCTIONS. A. E. [Ye] Glauber. Translated from *Doklady Akad. Nauk S.S.S.R.* 89, 659-62(1953). 4p. (NSF-tr-126)

Equations for equilibrium distribution functions of a condensed system of  $N$  identical molecules are developed, with minimum recourse to the postulates of statistical mechanics. It is shown that the equilibrium distributions of Maxwell and Gibbs are directly connected with the generalized results of such considerations. (K.S.)

## NEUTRONS

1185

Los Alamos Scientific Lab.

ON THE SPECTRUM OF AN UNSYMMETRIC OPERATOR ARISING IN THE TRANSPORT THEORY OF NEUTRONS. Joseph Lehner and G. Milton Wing. [1953?] 25p. Contract W-7405-eng-36. (AECU-2762)

1186

Phillips Petroleum Co., Atomic Energy Div.

SCATTERING OF SLOW NEUTRONS BY Be AND NaCl CRYSTALS. M. W. Holm. Dec. 2, 1953. 39p. Contract AT(10-1)-205. (IDO-16115)



The relative intensities of Bragg reflections of slow neutrons from a number of Be and NaCl crystal planes are calculated for the first three orders, and the results are presented in both graphic and tabular form. Potential scattering and mirror reflections are discussed briefly, and methods for estimating their magnitudes are indicated. The Debye-Waller temperature-correction factor and the crystal-structure factor are examined with a view to determining conditions leading to maximum order discrimination consistent with resolution and intensity requirements. (auth)

1187

THE STANDARDIZATION OF NEUTRON MEASUREMENTS. A. Wattenberg. *Ann. Rev. Nuclear Sci.* **3**, 119-40(1953).

Techniques are discussed for the relative and absolute measurement of neutron flux, neutron density, and the number of neutrons emitted by a source. Since the techniques employed depend, in general, upon the energy of the neutron, the discussion is divided according to energy regions (above 15 Mev, from 0.01 to 15 Mev, and below 0.01 Mev). A section containing general remarks for neutrons of all energies is also included. 84 references. (L.M.T.)

# NUCLEAR PHYSICS

1188

Laboratory for Nuclear Science, Mass. Inst. of Tech. COSMIC RAY GROUP; ELEMENTARY PARTICLE SCATTERING GROUP; AND NEUTRON PHYSICS GROUP. p. 29-43 of PROGRESS REPORT NO. 30 [FOR] MAY 31, 1953 TO AUGUST 31, 1953. Aug. 31, 1953. 15p. Contract AT(30-1)-905. (AECU-2740(p.29-43))

Four cases of S-particle decay indicate the emission of a single particle and a  $\gamma$  ray. Present evidence indicates, however, that such decay processes do not always yield  $\gamma$ -ray secondaries. The best S-particle mass value has been found to be  $1200_{-200}^{+270}$  m.e. Photofission fragment distributions and total fission yields have been determined for  $\text{Th}^{232}$ ,  $\text{U}^{235}$ , and  $\text{U}^{238}$ . The photoneutron yields of  $\text{Ga}^{69}$  and  $\text{As}^{76}$  have been investigated by means of 330-Mev bremsstrahlung. The excitation of heavy nuclei by the electric field of bombarding protons has been experimentally verified by measurements of  $\gamma$  rays from the 2.5-Mev bombardment of Ta. The angular distribution of neutrons from  $\text{C}^{14}(\text{p},\text{n})\text{N}^{14}$  and  $\text{O}^{18}(\text{p},\text{n})\text{F}^{18}$  has been measured. The relative peak height above background of the 850-kev  $\gamma$  ray per neutron incident on an  $\text{Fe}^{56}$  scatterer is presented as a function of neutron energy. (K.S.)

1189

Laboratory for Nuclear Science, Mass. Inst. of Tech. ONR GENERATOR GROUP AND RADIOACTIVITY GROUP. p.44-60 of PROGRESS REPORT NO. 30 [FOR] MAY 31, 1953 TO AUGUST 31, 1953. Aug. 31, 1953. 17p. Contract AT(30-1)-905. (AECU-2740(p.44-60))

The proton groups resulting from 5.74-Mev deuteron bombardment of  $\text{V}^{51}$  have been studied by the use of a high-resolution spectrometer in order to investigate the excited states of  $\text{V}^{52}$ . An energy level diagram for  $\text{V}^{52}$ , based on these results, is given. An experimental procedure is described for measuring the  $\gamma$ -ray angular distributions from the two-quantum annihilation of positrons at high energy. Good agreement between theory and experiment was obtained for energies of 765, 1020, 2220, and 3320 kev. Experiments on the coincidence activity of  $\text{Ca}^{48}$  lead to results which are compatible with a double-beta-decay mechanism, yielding a lifetime of  $5 \pm 2 \times 10^{16}$  yr. (K.S.)

1190

Laboratory for Nuclear Science, Mass. Inst. of Tech. CYCLOTRON GROUP; SYNCHROTRON GROUP; AND THEORETICAL GROUP. p.61-77 of PROGRESS REPORT NO. 30 [FOR] MAY 31, 1953 TO AUGUST 31, 1953. Aug. 31,

1953. 18p. Contract AT(30-1)-905. (AECU-2740(p.61-77))

The design and testing of a  $5 \times 5$  matrix pulse multiplier is described. Q values for (d,p) reactions with a number of nuclei are tabulated. Further results in the simplification of the relativistic two-particle equation are reported, together with studies on the development of a group model for an investigation of the properties of odd-odd nuclei. The effect of configuration interaction on the energy levels of even-even nuclei is examined. (K.S.)

1191

Wisconsin Univ. MAGNETIC INTERACTIONS ON THE BASIS OF A MODIFIED SHELL MODEL OF COMPLEX NUCLEI (thesis). Anatole Boris Volkov. 1953. 95p. [Contract AT(11-1)-30]. (AECU-2754)

The independent-particle Mayer-Jensen shell model does not give quantitative agreement with measured static magnetic moments of most odd-even nuclei and gives qualitative disagreement with certain measured magnetic dipole(M1) isomeric transitions. Results from the use of a modified shell model show an improved agreement both with the experimentally observed magnetic moments and isomeric transitions, indicating that the Mayer-Jensen model gives an inadequate description of the nuclear ground state wave functions. Although this modified shell model represents an improvement in describing the nuclear wave functions, it is emphasized that both interference and exchange effects were neglected in the analysis of the data. (L.M.T.)

1192

Commissariat à l'Énergie Atomique (France) RAPPEL DE LA CLASSIFICATION DES TRANSITIONS ISOMÉRIQUES CONNUES. [RECONSIDERATION OF THE CLASSIFICATION OF KNOWN ISOMERIC TRANSITIONS.] R. Ballini, C. Levi, and L. Papineau. Mar. 1953. 30p. (CEA-179)

The relations of Berthelot (liquid drop model) and of Weisskopf (odd level with "celibate" proton) between the transition energy and the "partial period" of emission of a photon  $\gamma$  are represented by easily utilized graphs. These relations are compared to the empirical relations for a certain number of transition groups. For the M4 transitions, a rectification is given for the mode of treatment from the experimental results obtained by Goldhaber and Sunyar. An attempt was made to systematize the energy of the isomeric transitions (grouping around certain energies and variation of the nature and energy of the transitions with Z, N, and A). (tr-auth)

1193

Nuclear Physics Labs., Columbia Univ. PROGRESS REPORT FOR OCTOBER, NOVEMBER, DECEMBER 1952 TO THE UNITED STATES ATOMIC ENERGY COMMISSION. 38p. Contract AT-30-1-GEN-72. (CU-125)

The neutron cross section of high-purity Al in the region 3 to 100 ev has been redetermined as 1.43 b. The Doppler broadening of resonance levels has been studied. Neutron resonances and Doppler broadening effects are reported for the 16.6-ev resonance of Ag, and the ratio of scattering to total cross section is investigated for the 2.36-ev resonance of Te. Cross sections for the paramagnetic scattering of neutrons in ferromagnetic ferrite, above and below the Curie point, are given together with slow neutron cross sections for the bound H atom in  $\text{H}_2\text{O}$  and polyethylene. A detection chain circuit for the slow neutron velocity selector is proposed, which separates the requirement of rapid rise time and rapid completion of transfer. The results of a study on the electron and  $\gamma$  spectra of  $\text{Bi}^{210}$  and  $\text{Pb}^{210}$  are reported. Scintillation and proportional counter investigations of inner-bremsstrahlung in the  $\text{Bi}^{210}$

nucleus are in agreement with theoretical predictions. Correlations between the electron and recoil nucleus in the  $\beta$  decay of  $\text{He}^6$  were measured in an improved "neutrino" apparatus, for the purpose of analyzing the extent of tensor and/or axial vector interactions. Data presented in graphical form indicate the predominance of tensor interactions in the  $\text{He}^6$ - $\text{Li}^6$  transition. Further progress on the design and testing of a pulse transformer accelerator is reported. (For preceding period see CU-117.) (K.S.)

1194

FOURTH ORDER PROCESSES OF FERMI INTERACTIONS. P. Budini. *Nuovo cimento* (9) 10, 1486-8(1953). Oct. 1. (In Italian)

The elements of the matrix of the fourth-order process in the Fermi-Dirac particles can be made to converge by the introduction of nonlocalization in the interaction. (J.S.R.)

1195

LONG RANGE NUCLEAR FORCES. H. C. Corben. *Nuovo cimento* (9) 10, 1485(1953). Oct. 1. (In English)

Fourth-order diagrams representing consequences of the Fermi theory of  $\beta$  decay are given. (J.S.R.)

1196

THE IONIZATION AND RADIATION OF ČERENKOV. P. Budini and L. Taffara. *Nuovo cimento* (9) 10, 1489-92(1953). Oct. 1. (In Italian)

From the general formula which allows the calculation of the energy locally dissipated by an ionizing particle (NSA 7-2915) a formula is derived for the number of primary ions created along the track of the particle. The formula giving the energy dissipated by Cherenkov radiation is used to derive a formula for the number of Cherenkov photons found along the particle track. (J.S.R.)

1197

HALF-LIFE OF  $\text{Zr}^{88}$ . Earl K. Hyde. *Phys. Rev.* 92, 927 (1953) Nov. 15.

The half life of  $\text{Zr}^{88}$  has been determined to be 85 days by following the growth and decay of its 105-day  $\text{Y}^{88}$  daughter. (auth)

1198

METHOD FOR THE DETERMINATION OF THE END-POINT ENERGY OF BETA EMITTERS. M. Forro. *Phys. Rev.* 92, 931-3(1953) Nov. 15.

It was found that the absorption of  $\beta$  spectra in materials of high atomic number is exponential. The absorption coefficients in Au are inversely proportional to the  $3/2$  power of the end-point energy of the spectrum. This experimental law holds with 2% accuracy in the energy interval from 0.3 to 2.2 Mev and in the intensity domain from  $1/2$  to  $1/100$  of the original intensity, if a detector with less than 2% relative opening is used. The end-point energy of  $\beta$  emitters can, therefore, be determined by measuring only two points on a Au absorption curve and is expressed by the equation:  $E = 9\mu^{-2/3} + 0.015$  with 2% accuracy from 0.17 to 2.2 Mev, where  $E$  is the end-point energy in Mev and  $\mu$  the absorption coefficient in  $\text{cm}^2/\text{g}$ . (auth)

1199

INTRINSIC MAGNETIC MOMENT OF ELEMENTARY PARTICLES OF SPIN  $1/2$ . F. J. Belinfante. *Phys. Rev.* 92, 997-1001(1953) Nov. 15.

Fierz-Pauli's theory of spin- $3/2$  particles has been reformulated in a manner somewhat resembling the usual formulation of Dirac's equation for the electron. The discussion is simplified by complete reduction of the representation of the spatial rotation and reflection group by the field. The dependent variables can then be expressed in terms of the spin- $3/2$  field. The magnetic moment and the gyromagnetic ratio of "bare" spin- $3/2$  particles of charge

$q$  and mass  $m$  are found to be  $(q\hbar/2mc)$  and  $(q/3mc)$ , respectively. (auth)

## NUCLEAR PROPERTIES

1200

Argonne National Lab.  
MASSES, NEUTRON AND PROTON BINDING ENERGIES OF THE HEAVY ELEMENTS. J. R. Huizenga and L. B. Magnusson. Nov. 1953. 17p. Contract W-31-109-eng-38. (ANL-5158)

The neutron and proton binding energies of the heavy elements are calculated by assuming that the neutron binding energies of  $\text{Pb}^{208}$ ,  $\text{Pb}^{209}$ , and  $\text{Pb}^{210}$  are 3.87, 7.38, and 6.72 Mev, respectively. A mass of  $\text{Pb}^{208}$  is derived which employs all of the magnetic measurements of heavy masses in combination with heavy mass differences which are calculated from reaction-energy cycles. The masses of the other heavy elements are calculated from reaction data relative to the  $\text{Pb}^{208}$  mass. The masses and binding energies are to be regarded as preliminary, in that several critical decay energies need additional experimental verification. The example of the neutron binding energy of  $\text{Bi}^{210}$  is discussed. (auth)

1201

Radiation Lab., Univ. of Calif., Livermore  
PROTON DISTRIBUTION IN HEAVY NUCLEI. M. H. Johnson and E. Teller. Nov. 13, 1953. 3p. Contract W-7405-eng-48. (UCRL-4232)

It is reasoned that, from considerations connected with  $\beta$ -decay stability and Coulomb repulsion forces, a neutron excess is developed on the surface of heavy nuclei. Several consequences of this qualitative analysis in nucleon interactions are briefly noted. (K.S.)

1202

ISOMERIC STATES OF MOLYBDENUM-93. L. Katz and J. Goldemberg. *Nature* 172, 723-4(1953), Oct. 17.

Molybdenum foils were irradiated close to the target in a 22-Mev betatron with a total of 12,000 r delivered in a short time compared to 6.7 hr, and then the foils were counted in large-angle geometry. No 6.7-hr activity was observed, and from the accuracy of the measurements it was estimated that no more than 20 cpm could be attributed to the 6.7-hr  $\text{Mo}^{93}$  isomer. It was concluded that the integrated cross section for the  $\text{Mo}^{94}(\gamma, n)\text{Mo}^{93*}$  reaction is less than 0.06 Mev-b. Good yields have been reported previously for  $\text{Mo}^{93*}$  from the  $\text{Nb}^{93}(p, n)\text{Mo}^{93*}$  and the  $\text{Nb}^{93}(d, 2n)\text{Mo}^{93*}$  reactions. An interpretation of these results is presented on the basis of the spins involved. (L.M.T.)

1203

THE MODEL WITH INDEPENDENT PARTICLES AND EXCITATION OF HEAVY NUCLEI. A. Kind and G. Patergnani. *Nuovo cimento* (9) 10, 1375-87(1953). Oct. 1. (In Italian)

The model with independent particles in classical approximation is used for the description of particular features of the excitation of heavy nuclei in high energy reactions. The dependence of the transmission coefficient at the surface of the nucleus on the incidence angle leads to a residual excitation energy greater than the one obtained neglecting this dependence. Analyzing the variation with temperature of the mean free path of nucleons within the nucleus, it is seen that when it exceeds 7 to 8 Mev there is the possibility that the excitation energy concentrates in limited zones producing localized emission. In the particular case of reactions produced by protons of 400 Mev this should lead to an augmentation of the forward collimation of black prongs. It is suggested that with rising temperature the building of understructures within the nucleus should intensify with ensuing high percentage of heavy fragments and  $\alpha$  particles



in the emission originating from the more excited zones. (auth)

1204

NUCLEAR ISOMERISM IN  $\text{Ir}^{192}$ . G. Weber and A. Flammersfeld. *Z. Naturforsch.* **a8**, 580-1(1953). Sept. (In German)

Bombardment of Ir with slow neutrons produces a strong activity with a half life of 1.45 min, which decays to  $\text{Ir}^{192}$  and is isomeric to  $\text{Ir}^{192}$ . The spectrum of the conversion electron and decay scheme of  $\text{Ir}^{192}$  are diagramed. (J.S.R.)

1205

A PHOTOGRAPHIC MOMENTUM SPECTROGRAPH AND THE LEVELS OF THE  $\text{N}^{15}$  AND  $\text{O}^{17}$  INTERMEDIATE NUCLEI. Gerhart von Gierke. *Z. Naturforsch.* **a8**, 567-78 (1953). Sept. (In German)

The process applied by Stetter and Bothe to the Wilhelm method for the spectroscopy of highly excited intermediate nuclei for the evidence of side effects was improved, stabilized, and supplemented with a high resolution, continuous momentum spectrograph. The energy spectrum of the  $\text{N}^{14}(\text{n},\text{p})$  and  $(\text{n},\alpha)$  reaction products up to 3.3 Mev was measured and the term diagram of  $\text{N}^{15}$  between 11 and 15 Mev obtained. Satisfactory agreement can be obtained with further measurements, in which the ground state for the final nucleus will be known. To those already known, various terms were added. The  $\text{O}^{16}(\text{n},\alpha)$  reaction was investigated in the same way. Reaction products appear up to 7 Mev. By observation of the maxima, many excited states of the intermediate nucleus  $\text{O}^{17}$  between 7 and 13 Mev excitation energy were made possible, of which only a small part were already known. By means of the necessary energy, the ratio of the  $\alpha$  ionization power of  $\text{N}_2$  to  $\text{O}_2$  was determined to be  $1.10 \pm 0.01$ . (J.S.R.)

1206

MAGNETIC MOMENTS OF NEUTRON AND PROTON. F. J. Belinfante. *Phys. Rev.* **92**, 994-7(1953) Nov. 15.

After a discussion of the importance of results recently found by Sachs, some weaknesses of his theory are pointed out, and a contribution to the nucleon magnetic moment from the state with a two-pion cloud in an S-state is calculated. A proposal of Sugawara to include admixtures of states with a one-pion cloud around a spin- $\frac{3}{2}$  ("baryon") core is criticized, and the contribution of such states to the nucleon magnetic moments is calculated. It is discussed what value might be taken for the magnetic moment of such a "baryon" core. (auth)

## NUCLEAR REACTORS

1207

Atomic Energy Research Establishment, Harwell, Berks (England)

CONTROL AND INSTRUMENTATION OF AN AIR-COOLED THERMAL NEUTRON REACTOR. LECTURE NOTES.

R. V. Moore. Feb. 11, 1952. 13p. (AERE-R/L-2)

Discussions are presented regarding the control, instrumentation, and safety of a natural-U, graphite-moderated, air-cooled reactor working in the thermal neutron cycle and designed for research and isotope production. (auth)

1208

Commissariat à l'Énergie Atomique (France)

ETUDE DE FACTEUR DE MULTIPLICATION DANS LA PILE DE SACLAY. [STUDY OF THE MULTIPLICATION FACTOR OF THE SACLAY PILE]. B. Jacrot, F. Netter, and V. Ralevski. Oct. 1953. 26p. (CEA-215)

Methods were studied for measuring  $k_{\text{eff}}$  in a pile by experiments in a subcritical assembly. The methods were applied to a determination of the effects on reactivity due to  $\text{D}_2\text{O}$  level and control-rod position. The results of these

studies are used to establish relationships for the rise time and power level of the pile. (K.S.)

1209

Joint Establishment for Nuclear Energy Research (Norway) ABSOLUTE MEASUREMENTS OF NEUTRON DENSITIES IN THE JEEP. Bertel Grimeland. 1953. 8p. (JENER-20)

Values for neutron density at different positions in the reactor are given. Measurement of neutron densities by absolute  $\beta$  measurements has been extended to include the use of P rather than  $\text{NaI}(\text{Tl})$  crystals in the scintillation counter. (J.A.G.)

1210

Joint Establishment for Nuclear Energy Research (Norway) MEASUREMENTS OF NEUTRON DENSITY DISTRIBUTION IN THE JEEP BY COPPER BAND IRRADIATION. M. Bogaardt, W. Hålg, and J. Pelsler. 1953. 9p. (JENER-21)

A means for determining the neutron density distribution in the form of a continuous curve is presented. The method, which consists of activity measurements of an irradiated  $0.29 \text{ g/cm}^2$  flexible Cu band, gives well reproducible curves with an accuracy sufficient to show irregularities in the neutron distribution such as those caused by the presence of the fuel rods. (J.A.G.)

1211

THE FACTOR OF HEAT UTILIZATION AND THE MANNER OF THERMAL DIFFUSION IN A HETEROGENEOUS PILE. S. Gallone. *Nuovo cimento* (9) **10**, 1495-7(1953). Oct. 1. (In Italian)

For the case of very simple geometry, the conditions of criticality are deduced for a pile not having valid diffusion equations within a single cell. (J.S.R.)

## NUCLEAR TRANSFORMATION

1212

Commissariat à l'Énergie Atomique (France)

ETUDE COMPAREE DES DESINTEGRATIONS  $\beta$  ET DU MODELE DES COUCHES POUR LES NOYAUX DE A IMPAIR. [COMPARATIVE STUDY OF  $\beta$  DISINTEGRATIONS AND THE SHELL MODEL FOR ODD-A NUCLEI.] M. Trocheris. June 1953. 45p. (CEA-183)

A comparative study was made of  $\beta$  decay and of the shell model for odd-A nuclei. All of the  $\beta$  transitions known are tabulated except those between mirror nuclei, those not established experimentally, and those of an excited state not represented by the Moyer model. The transitions are classified according to the values of  $\log ft$ ,  $\log \phi_L t$ ,  $\log \gamma_1 t$ , and  $\log \gamma_L t$ . The validity of the shell model according to the  $\beta$  transitions is discussed. (J.S.R.)

1213

TWO-NUCLEON NUCLEAR TRANSITIONS. L. A. Sliv and L. K. Peker. *Doklady Akad. Nauk S.S.S.R.* **92**, 277-9(1953) Sept. 11. (In Russian)

A nucleus can have a mixed system of levels, with the transitions originating both in the hyper-excited level and in the unfilled level. The transition to the ground level of  $\text{Rb}^{85}$  is diagramed. The  $\beta$  transition from the isomeric states of  $\text{Kr}^{85*}$  and  $\text{Sr}^{85*}$  goes to the unfilled level  $p_{3/2}$  of nucleus  $\text{Rb}^{85}$ , but the  $\beta$  transition from the ground level in the same nuclei goes to the hyper-excited level  $g_{3/2}$ . Analogous situations occur in all isomeric nuclei, but sometimes the transition from the isomeric states goes to hyper-excited levels, whereas a transition from the ground state goes to the unfilled level. Therefore,  $\beta$  transitions from isomeric nuclei lead to the appearance of levels of two different systems. A mixed system of levels occurs in nucleus Z after  $\beta^-$  and  $\beta^+$  transition from the nuclei  $Z - 1$   $Z + 1$ . The energy levels of  $\text{Ni}^{61}$  from the transition from  $\text{Co}^{61}$  and  $\text{Cu}^{61}$  are diagramed. A second system is possible in complex  $\beta$  disintegrations with both permitted and for-

bidden transitions. The forbidden transitions go to the unfilled level, while the permitted transitions go to hyper-excited levels. The  $\beta$  disintegration of  $\text{Sr}^{91}$  and the resultant excitation levels of  $\text{Y}^{91}$  are diagramed. (J.S.R.)

1214

**GAMMA RAYS FROM PROTON BOMBARDMENT OF  $\text{B}^{10}$ .** R. W. Krone and L. W. Seagondollar. *Phys. Rev.* **92**, 935-7(1953) Nov. 15.

The  $\gamma$ -ray spectrum resulting from the radiative decay of  $\text{C}^{11}$ , produced by the proton bombardment of  $\text{B}^{10}$ , has been investigated by means of thick and thin targets. Observations were made for proton energies ranging from 500 kev to 1.7 Mev. A broad resonance with a maximum at 780 kev appears well established. The compound nucleus decays in a one-step transition to the ground state of  $\text{C}^{11}$  with the emission of a  $\gamma$  ray of energy approximately equal to 9 Mev. The existence of two other resonances, observed for proton energies of 0.95 and 1.33 Mev, is less certain. (auth)

1215

**EXCITATION FUNCTION FOR THE PHOTODISINTEGRATION OF BERYLLIUM.** R. Nathans and J. Halpern. *Phys. Rev.* **92**, 940-1(1953) Nov. 15.

By use of filtered betatron bremsstrahlung, the  $\text{Be}^8(\gamma, n)$  excitation function has been determined from threshold to 24 Mev. The results show two peaks, one due to excitation of the odd neutron and the second to the excitation of the  $\text{Be}^8$  core. (auth)

1216

**SPONTANEOUS FISSION YIELDS FROM URANIUM AND THORIUM.** George W. Wetherill. *Phys. Rev.* **92**, 907-12(1953) Nov. 15.

Relative spontaneous fission yields from U and Th have been determined by extracting Xe-Kr from geologically old U and Th minerals and measuring the isotopic abundances of these gases in a mass spectrometer. Arguments are presented for believing that the anomalous isotopic abundances observed are caused by spontaneous fission rather than by some other fission process. The spontaneous fission-yield-curve peaks were found to be much sharper than those associated with other fission processes. Evidence was found for fine structure in the fission yield curve at mass 132, possibly connected with preferential formation of spontaneous fission fragments containing 50 protons and 82 neutrons. Evidence for neutron-induced fission in pitchblende was found. (auth)

## PARTICLE ACCELERATORS

1217

Radiation Lab., Univ. of Calif., Berkeley  
**BERKELEY PROTON LINEAR ACCELERATOR.** Luis W. Alvarez, Hugh Bradner, Jack Franck, Hayden Gordon, J. Donald Gow, Lauriston C. Marshall, Frank F. Oppenheimer, Wolfgang K. H. Panofsky, Chaim Richman, and John R. Woodyard. Oct. 13, 1953. 83p. Contract W-7405-eng-48. (AECU-120(rev.); UCRL-236(rev.))

A linear accelerator, which increases the energy of protons from a 4-Mev Van de Graaff injector to a final energy of 31.5 Mev, has been constructed. The accelerator consists of a cavity 40 ft long and 39 in. in diam. excited at resonance in a longitudinal electric mode with a r-f power of about  $2.2 \times 10^6$  w peak at 202.5 mc. Acceleration is made possible by the introduction of 46 axial "drift tubes" into the cavity, which is designed such that the particles traverse the distance between the centers of successive tubes in one cycle of the r-f power. The protons are longitudinally stable as in the synchrotron and are stabilized transversely by the action of converging fields produced by focusing grids. The electrical cavity is constructed like an inverted airplane fuselage and is supported in a vacuum tank. Power is sup-

plied by 9 high-powered oscillators, fed from a pulse generator of the artificial transmission-line type. Output currents are  $3 \times 10^{-8}$  amp average and 50  $\mu$ a peak. The beam has a diam. of 1 cm and an angular divergence of  $10^{-3}$  radians. (auth)

1218

[Sloane Physics Lab., Yale Univ.]  
**YALE LINEAR ELECTRON ACCELERATOR. STATUS REPORT [FOR] MARCH 1953.** H. L. Schultz and W. G. Wadey. Mar. 31, 1953. 5p. Contract AT(30-1)-1349. (AECU-2769)

Initial component design of the Yale linear electron accelerator is reported. The project is 39% complete. (K.S.)

1219

[Sloane Physics Lab., Yale Univ.]  
**YALE LINEAR ELECTRON ACCELERATOR. STATUS REPORT [FOR] APRIL 1953.** H. L. Schultz and W. G. Wadey. Apr. 30, 1953. 4p. Contract AT(30-1)-1349. (AECU-2770)

The accelerator is 45% complete. Certain design details of the digital spectrometer are reported. (For preceding period see AECU-2769.) (K.S.)

1220

[Sloane Physics Lab., Yale Univ.]  
**YALE LINEAR ELECTRON ACCELERATOR. STATUS REPORT [FOR] MAY 1953.** H. L. Schultz and W. G. Wadey. May 31, 1953. 3p. Contract AT(30-1)-1349. (AECU-2771)

The status of the electron linear accelerator project is reported. The over-all project is 52% complete. (For preceding period see AECU-2770.) (K.S.)

1221

Commissariat à l'Énergie Atomique (France)  
**OSCILLATIONS DE LA COLONNE DU GÉNÉRATEUR ÉLECTROSTATIQUE TYPE VAN DE GRAAFF 5 MEV. [OSCILLATIONS IN THE COLUMN OF THE 5 MEV VAN DE GRAAFF ELECTROSTATIC GENERATOR.]** G. Armand. June 1953. 32p. (CEA-186)

One belt, or two belts operating simultaneously, in the Van de Graaff generator causes transverse and longitudinal oscillations in the column wall. The transverse oscillations are studied, and their parameters were determined. The relation of the transverse oscillations to the fixed space allows a linear system for the Van de Graaff column, which can be theoretically defined. In a horizontal plane the maximum and minimum oscillations are given by the N-S and E-W directions, respectively. The period increases with the parameter "mass"; the extremes in the experimental limits and for the "fundamental" period are 0.6 and 0.91 sec. This period remains constant, in these limits, when the tension of the belt varies. The oscillations are sinusoidal. The south belt is responsible for the amplitudes observed. The amplitude of the oscillations appears to increase with the belt tension. (J.S.R.)

1222

Commissariat à l'Énergie Atomique (France)  
**LE TUBE ACCELERATEUR D'IONS DU GÉNÉRATEUR VAN DE GRAAFF DU COMMISSARIAT. [THE ION ACCELERATOR TUBE OF THE COMMISSION'S VAN DE GRAAFF GENERATOR.]** H. Bruck, F. Prévot, and W. O. McMinn. July 1953. 63p. (CEA-189)

The design and development of the ion accelerator tube of the Van de Graaff generator are described. A general discussion of the physical dimensions and properties of the tube are given. It is 3.75 m high with an average gradient of 13.3 kv/cm for a 5-Mv total, subdivided into 50 identical elements 75 cm high. Each element, with a free interior diameter of 16 cm and an interior diameter over



the insulator of 25 cm, has to support 100 kv. Degassing of the tube is described. An experimental study of the dielectric properties of a tube element is reported. Experiments were performed to determine the maximum d-c voltage which could be applied to assemblies of stainless steel electrodes separated by an insulator in a vacuum without sparking. Procelain insulators with corrugated inner wall surfaces had the highest breakdown voltages, 240 kv. The properties and performance of the tube are discussed. (J.S.R.)

1223

Commissariat à l'Énergie Atomique (France)  
REGULATEUR DE COURANT POUR STABILISATION D'UN  
GENERATEUR ELECTROSTATIQUE VAN DE GRAAFF.  
[CURRENT REGULATOR FOR STABILIZATION OF A  
VAN DE GRAAFF ELECTROSTATIC GENERATOR].  
A. Gabet and J. Taieb. Sept. 1953. 12p. (CEA-213)

A high-voltage current regulator for a 5-Mev Van de Graaff accelerator is described. Provision is made for varying the high-voltage supply between 0 and 80 kv. (K.S.)

1224

Commissariat à l'Énergie Atomique (France)  
ESSAI DE COMPARISON DES GENERATEURS ELECTRO-  
STATIQUES DE VAN DE GRAAFF ET DE PAUTHENIER.  
[COMPARISON OF THE VAN DE GRAAFF AND DE  
PAUTHENIER ELECTROSTATIC GENERATORS].  
F. Prevot. Sept. 1953. 23p. (CEA-214)

The operation of a de Pauthenier electrostatic generator is discussed. It is shown that, whereas such a machine is capable of speeds 4 or 5 times greater than the Van de Graaff generator, certain limitations imposed by the flow of ion currents limit operation to pressures below 5 atm. (K.S.)

1225

Radiation Lab., Univ. of Calif., Berkeley  
INSTRUCTIONS FOR USE OF A 184-INCH CYCLOTRON  
GAS RECOVERY SYSTEM. John Ise, Jr. and George P.  
Millburn. Oct. 1, 1953. 11p. Contract W-7405-eng-48.  
(UCRL-2354)

A flow diagram and operating instructions are presented for the gas-recovery system designed to recirculate He through the cyclotron. The gas being returned to the cyclotron is purified so as to remove all gases except He, H, and Ne. (L.M.T.)

1226

PROTON SYNCHROTRON OF THE UNIVERSITY OF  
BIRMINGHAM. *Nature* 172, 704-6(1953). Oct. 17.

A brief description is presented of the Univ. of Birmingham synchrotron, which is able to accelerate protons to an energy of 1 bev. (L.M.T.)

## RADIATION ABSORPTION AND SCATTERING

1227

Los Alamos Scientific Lab.  
CHARGED PARTICLES FROM THE INTERACTION OF 14-  
MEV NEUTRONS WITH  $\text{Li}^6$  AND  $\text{Li}^7$ . Glenn M. Frye, Jr.  
[1953] 31p. (AECU-2758)

The angular distribution of the charged particles produced in the bombardment of  $\text{Li}^6$  and  $\text{Li}^7$  by 14-Mev neutrons was observed with nuclear emulsions in a multi-plate camera. Metallic targets of enriched  $\text{Li}^6$  and  $\text{Li}^7$  were used. The following cross sections were measured:  $\text{Li}^6(n,p)\text{He}^3$ ,  $6 \pm 2$  mb;  $\text{Li}^6(n,d)\text{He}^3$ ,  $89 \pm 10$  mb;  $\text{Li}^6(n,d)\text{He}^{3*}$ ,  $77 \pm 9$  mb;  $\text{Li}^6(n,t)\text{He}^4$ ,  $26 \pm 4$  mb;  $\text{Li}^7(n,t)\text{He}^3$ ,  $55 \pm 8$  mb. The reaction  $\text{Li}^7(n,d)\text{He}^3$  was also observed but was not well enough resolved to give an angular distribution and total cross section. No evidence was found for the formation of  $\text{He}^3$  by  $\text{Li}^7(n,p)\text{He}^3$  with a cross section greater than 5 mb in the range  $-1.0 > Q > -7.0$  Mev. The angular distribu-

tions obtained for  $\text{Li}^6(n,d)\text{He}^3$  and  $\text{Li}^6(n,d)\text{He}^{3*}$  indicate that these reactions proceed mainly by an inverse stripping or pickup process. The energy spectrum of the neutrons from  $\text{Li}^6(n,d)\text{He}^3(n)\text{He}^4$  and  $\text{Li}^6(n,d)\text{He}^{3*}(n)\text{He}^4$  is calculated by using several assumptions for the angular distribution of the  $\text{He}^3$  disintegration. (auth)

1228

Brookhaven National Lab.

TOTAL CROSS SECTION OF PIONS AT 1.5 BEV. R. L. Cool, L. F. Madansky, and O. Piccioni. [Oct. 30, 1953]. 5p. (BNL-1625)

The total cross sections of negative pions on H and the D-H difference have been measured for a pion kinetic energy of 1.5 bev. The pions were produced in the Brookhaven Cosmotron by bombarding a Be target with the 2.3-bev proton beam. The negative mesons emitted in the forward direction were deflected by the Cosmotron magnet into a 6- by 6-in. channel in the 8-ft-thick concrete shield. The beam outside the shield was defined by a telescope of two liquid scintillation counters in front of a deflecting magnet and two behind. The magnetic analysis of the beam agreed very well with the incident momentum of 1.7 bev/c with a spread of  $\sim 20$  mev/c as expected from graphical analysis of the dispersion of the Cosmotron magnet. (auth)

1229

Commissariat à l'Énergie Atomique (France)  
PRODUCTION DE NEUTRONS DE TRÈS BASSE ÉNERGIE  
PAR FILTRATION A TRAVERS DU GRAPHITE ET  
MESURE DE SECTIONS EFFICACES TOTALES. [PRO-  
DUCTION OF VERY LOW ENERGY NEUTRONS BY  
FILTRATION THROUGH GRAPHITE AND MEASUREMENT  
OF TOTAL CROSS SECTIONS]. A. Ertaud and R. Beauge.  
Jan. 1953. 10p. (CEA-162)

An apparatus for the production and measurement of very low-energy neutrons is described. Neutron total cross sections of  $\text{H}_2\text{O}$  and  $\text{D}_2\text{O}$  were measured for neutron energies down to 0.0017 ev. (K.S.)

1230

Commissariat à l'Énergie Atomique (France)  
UNE METHODE DE PRODUCTION DES PARTICULES  $\alpha$ .  
[A METHOD FOR THE PRODUCTION OF  $\alpha$  PARTICLES].  
F. Prevot. July 1953. 9p. (CEA-188)

A method is proposed for obtaining a beam of intense  $\alpha$  particles. From an ordinary ion source, a once-ionized beam of He is formed which is accelerated to an energy of several hundred kilovolts. While passing through matter, in the form of a thin foil or gas film, the second He electron is stripped with a yield which depends only on the energy of the He beam. (tr-auth)

1231

Ames Lab.

PARTICLE DISTRIBUTIONS FROM A THIN SOURCE IN  
CONTACT WITH A COLLIMATOR. Glenn H. Miller.  
Nov. 2, 1953. 18p. Contract W-7405-eng-82. (ISC-419)

Calculations have been made on various quantities associated with a thin-particle source in contact with a collimator consisting of a flat plate with cylindrical holes. Expressions have been obtained for the distribution in angle for the emitted particles, the track-length distribution in the source, and the total counting rate for any maximum angle. The total counting rate falls off very rapidly as the collimation is made more severe. It is concluded that the use of a collimator is not generally advisable, unless it is necessary to restrict the particles to a small angular spread. For such cases the expressions obtained make possible a rapid calculation of such quantities as the source thickness necessary for a given counting rate and the resulting distribution in energy loss in the source. (auth)

1232

Joint Establishment for Nuclear Energy Research (Norway)  
ČERENKOV-RADIATION FROM THE HEAVY WATER IN  
JEEP. K. Skarsvåg and A. Lundby. Oct. 28, 1953. 5p.  
(JENER-22)

The Cherenkov radiation from  $D_2O$  in the JEEP reactor tank has been examined. The experimental apparatus, using an EMI 6260 photomultiplier and associated electronic circuitry, is described, and measured radiation levels are graphically presented as a function of reactor power. (K.S.)

1233

Radiation Lab., Univ. of Calif., Berkeley  
ENERGY AND IONIZATION OF LIGHT PARTICLES AS A  
FUNCTION OF  $H_p$ . Donald Johnson. Aug. 1951. 4p.  
Contract W-7405-eng-48. (UCRL-1445)

1234

EXTRANUCLEAR INTERACTIONS OF ELECTRONS AND  
GAMMA RAYS. D. R. Corson and A. O. Hanson. *Ann. Rev. Nuclear Sci.* **3**, 67-92(1953).

Experimental work during the past few years on the extranuclear interactions of  $\gamma$  rays and electrons is reviewed, with enough background theory included to give the experiments perspective. Emphasis is placed on the interactions at higher energies. Sections are included on nuclear scattering of electrons and positrons, effect of nuclear size, scattering of electrons and positrons by electrons, multiple scattering, ionization loss, pair production, and bremsstrahlung. 110 references. (L.M.T.)

1235

REACTIONS OF  $\pi$ -MESONS WITH NUCLEONS. E. M. Henley, M. A. Ruderman, and J. Steinberger. *Ann. Rev. Nuclear Sci.* **3**, 1-38(1953).

The properties of free  $\pi$  mesons such as charge, mass, spin, decay modes, and mean life are very briefly summarized. The main treatment concerns recent experimental results on the scattering and photoproduction of  $\pi$  mesons by single nucleons. Theoretical considerations are limited to an introductory section on the implications of charge symmetry and independence in the pion-nucleon reactions. 90 references. (L.M.T.)

1236

SCATTERING OF A PARTICLE WITH DIRAC CHARGE BY  
AN ELECTROSTATIC SCATTERING CENTER. Paul  
Roussopoulos. *Compt. rend.* **237**, 1397-9(1953) Nov. 30.  
(In French)

An approximate expression is derived for the effective scattering cross section for a particle with Dirac charge by an electrostatic scattering center. (J.S.R.)

1237

LARGE-ANGLE SCATTERING OF  $Co^{60}$  GAMMA RAYS.  
Thomas D. Strickler. *Phys. Rev.* **92**, 923-6(1953) Nov. 15.

Measurements of the scattering of  $Co^{60}$   $\gamma$  rays from Pb, Sn, Cu, and Al have been made at a mean angle of  $135^\circ$ . In addition to Compton scattering and annihilation radiation, some higher energy components are present. Elastic scattering was observed in each of these scatterers, and the cross section for this process has been measured. Results are shown to be consistent with recent theoretical calculations on Rayleigh and Thomson scattering. (auth)

1238

INFLUENCE OF ELECTRIC AND MAGNETIC FIELDS ON  
ANGULAR CORRELATIONS. A. Abragam and R. V. Pound. *Phys. Rev.* **92**, 943-62(1953) Nov. 15.

The theory of the influence on angular correlations of perturbing interactions in the intermediate state is reformulated to allow the description of the effects of time-dependent as well as of static perturbations. For static

interactions of the nuclear electric quadrupole moment with crystalline fields of axial symmetry in polycrystalline sources, attenuation factors are calculated for the coefficients of the various terms in the expansion of the correlation function in Legendre polynomials. No matter how strong the quadrupole interaction, some anisotropy must remain for polycrystalline sources but, for the same interaction in simple single crystals, the anisotropy can be either undisturbed or completely destroyed, depending on the orientation of the crystal. Fields of lower symmetry are shown also to leave, for polycrystalline sources, some anisotropy. Expressions for the influence of randomly fluctuating interactions, such as must exist in liquid sources, are calculated, and these predict arbitrarily complete destruction of the correlation under certain conditions but explain the more nearly unperturbed results usually found with such sources. For electronic shells having magnetic moments, the influences of electronic paramagnetic relaxation and of anisotropy of the hfs interaction are examined. An applied static magnetic field in the presence of static quadrupole interactions in polycrystalline sources is shown to have differing effects depending on the relative strengths of the two interactions. Application of a magnetic field directed toward a counter cannot reduce the disturbance of the intermediate state in liquid sources, except under special circumstances. The influences of an applied field in the presence of time-dependent anisotropic hfs interactions are discussed. Finally, the feasibility of resonance experiments, for the precise determination of nuclear moments in the intermediate state, is explored. (auth)

1239

RESONANT EFFECTS AND SPIN DEPENDENCE IN  
POTENTIAL SCATTERING OF SLOW NEUTRONS. W. Selove. *Phys. Rev.* **92**, 941-2(1953) Nov. 15.

The potential scattering of a nucleus can be considerably different from  $4\pi R^2$ , where  $R$  is the size of the nucleus, if the potential-well parameters happen to give an appreciable resonance effect. Strong resonance effects are expected to be accompanied by strong spin dependence. The potential scattering of Be shows an appreciable resonant effect but very small spin dependence in the scattering cross section. From an examination of the numerical parameters involved it is concluded that the small spin dependence in the cross section does not preclude a moderate amount of spin dependence in the potential wells for the two spin states—the close equality of the two scattering lengths involved may be the result of a coincidental combination of well depths and ranges. (auth)

1240

COMPTON SCATTERING OF 2.62-MEV GAMMA RAYS BY  
POLARIZED ELECTRONS. S. B. Gunst and L. A. Page. *Phys. Rev.* **92**, 970-3(1953) Nov. 15.

The differential cross section for Compton scattering of a circularly polarized photon by an electron with given initial spin orientation can be written as a sum of the common Klein-Nishina formula for no polarization and a term sensitive to polarization. The total cross section is  $\sigma = \sigma_0 \pm \sigma_1$ . A measurement of the transmission of 2.62-Mev  $\gamma$  rays through Fe magnetized along the transmission direction relative to that through unmagnetized Fe gives the absolute value of  $\sigma_1$  for this energy, if the number of  $\nu_s$  of polarized electrons per Fe atom at saturation is known. For  $\nu_s = 2.06$ ,  $\sigma_1/\pi r_e^2 = 0.089 \pm 0.007$ . This agrees with the theoretical value 0.093. Alternatively, the theoretical  $\sigma_1$  and the measurements would yield  $\nu_s = 1.97 \pm 0.15$ . The application of the method of this experiment to measurement of gyromagnetic ratios for ferromagnets is suggested, as is its application to the analysis of circularly polarized radiation. (auth)



## RADIOACTIVITY

1241

Los Alamos Scientific Lab.

ANGULAR CORRELATION AND COINCIDENCE STUDIES OF ALPHA-GAMMA CASCADES FROM PROTACTINIUM<sup>231</sup>, CURIUM<sup>242</sup>, AND AMERICIUM<sup>241</sup> (thesis). Richard Lee Moore. 1953. 152p. Contract W-7405-eng-36. (AECU-2757)

The decay schemes and the spins and parities of some excited states of the daughter nuclei of the  $\alpha$  emitters Pa<sup>231</sup>, Cm<sup>242</sup>, and Am<sup>241</sup> were studied. The tools used include a  $\gamma$  scintillation spectrometer with associated amplifiers and pulse-height analyzers and a coincidence system with a resolving time of about  $5 \times 10^{-8}$  sec, which could be used to measure half lives between  $2 \times 10^{-6}$  sec, and  $5.0 \times 10^{-7}$  sec by delayed-coincidence techniques. Spins of the states, properties of the radiations, and angular correlations between  $\alpha$  particles and  $\gamma$  rays emitted in cascade were obtained with the aid of the coincidence circuit and the appropriate mechanical apparatus for rotating one of the detectors about the source. (auth)

1242

Palmer Physical Lab., Princeton Univ.

BETA GAMMA POLARIZATION CORRELATIONS. Donald R. Hamilton, Palmer Physical Lab., Princeton Univ. and Institute for Advanced Study, Princeton; and Aaron Lemonick and Francis M. Pipkin, Princeton Univ. Aug. 1, 1953. 29p. Contract AT(30-1)-937. (NYO-6180)

The polarization of the  $\gamma$  ray emitted at an angle of  $90^\circ$  to the preceding  $\beta$  particle has been measured for certain  $\beta$ - $\gamma$  cascades in K<sup>42</sup>, As<sup>76</sup>, Rb<sup>86</sup>, Sb<sup>124</sup>, and Cs<sup>134</sup> as selected by  $\beta$  absorbers when necessary. The polarimeter was checked by observing the polarization of the  $\gamma$  rays of Cs<sup>137</sup> and Co<sup>60</sup> when Compton scattered through  $90^\circ$ . Of the  $\gamma$  rays investigated, those of K<sup>42</sup> and Cs<sup>134</sup> have no observable polarization. For the other 3 elements the sign of the polarization correlation, taken in combination with the sign of the angular correlation reported by other observers, uniquely determines that no parity change occurs in the  $\gamma$  emission, corresponding to electric quadrupole radiation in decay of the excited state. (auth)

1243

Oak Ridge National Lab.

INTERACTION EFFECTS IN  $\beta$ -DECAY. M. E. Rose. Issued Dec. 28, 1953. 14p. Contract W-7405-eng-26. (ORNL-1645)

Even with sensible nonrelativistic wave functions the small components of the relativistic wave function are needed, not only for the odd operators of the  $\beta$ -decay interaction but also for even operators if such phenomena as  $l$ -forbiddenness is accounted for. The problem which presents itself is: given the nonrelativistic zero order wave functions, how are the so-called small components to be obtained? This problem is answered, to a certain degree of approximation, in the course of this consideration of the interaction effect. (auth)

1244

AN ISOTOPIC-SPIN INVARIANT THEORY OF  $\beta$ -DECAY. V. V. Sudakov. Translated from *Doklady Akad. Nauk S.S.S.R.* 90, 1009-10(1953). 2p. (NSF-tr-130)

An abstract of this report appears in *Nuclear Science Abstracts* as NSA 7-5654.

1245

CALCULATION OF CASCADE TRACKS. R. Cester and E. Clementel. *Nuovo cimento* (9) 10, 1441-50(1953). Oct. 1. (In Italian)

Starting from a solution of cascade theory given by a series of the kind used by Bhabha and Chakrabarty, the track length problem is solved both for electrons and pho-

tons. It is shown that it is possible to give a recurrence formula for the terms of the series. For  $E = 0$  the series is indeterminate, but imposing the integral electron track length to satisfy the energy conservation condition, the results are in good agreement with previous calculations. (auth)

1246

GAMMA RAYS EMITTED FROM <sup>60</sup>Co, <sup>56</sup>Mn, <sup>187</sup>W, <sup>128</sup>I, <sup>104</sup>Rh. E. Germagnoli and A. Malvicini. *Nuovo cimento* (9) 10, 1388-1405(1953). Oct. 1. (In English)

A coincidence arrangement of two single-crystal spectrometers, suitable to the analysis of decay schemes of radioisotopes, has been developed. The  $\gamma$  radiations from Co<sup>60</sup>, Mn<sup>56</sup>, and W<sup>187</sup> were studied, and the spectra are given. The  $\gamma$  spectra of I<sup>128</sup> and Rh<sup>104</sup> were examined by means of a single-crystal spectrometer. (auth)

1247

ANGULAR CORRELATION IN THE  $\gamma$ - $\gamma$  CASCADE OF Po<sup>214</sup>. F. Demichelis and R. Malvano. *Nuovo cimento* (9) 10, 1359-66(1953). Oct. 1. (In Italian)

The angular correlation of the  $\gamma$ - $\gamma$  cascade from the decay of Po<sup>214</sup> was studied by means of scintillation counters. Two types of cascades were found: one with  $a_{11} = 3/7$  and  $a_{12} = 0$  and the other with  $a_{21} = 15/13$  and  $a_{22} = 16/13$ . It is suggested that the first type consists of a quadrupole-dipole transition with angular moments  $J_1 = 0^+$ ,  $J_2 = 1^-$ , and  $J_3 = 2^-$  or of a dipole-quadrupole with angular moments  $J_1 = 0^+$ ,  $J_1 = 2^+$ , and  $J_3 = 2^-$  for the three states in order of increasing excitation energy. The second type consists of a quadrupole-quadrupole transition with angular moments  $J_1 = 0^+$ ,  $J_2 = 2^+$ , and  $J_3 = 2^+$  for the three states in order of increasing excitation energy. (J.S.R.)

1248

THE INTERNAL CONVERSION ELECTRONS EMITTED IN THE DECAY OF IONIUM AND RADIO-THORIUM. C. J. D. Jarvis. *Proc. Phys. Soc. (London)* A66, 1074-5(1953). Nov.

Jarvis and Ross (*Proc. Phys. Soc. (London)* A64, 535 (1951)) suggested values of  $\sim 70$  kev for two indistinguishable  $\gamma$  transitions for the two conversion electrons occurring in a small percentage of  $\alpha$  disintegrations of Th<sup>230</sup>. In a reinvestigation of Th<sup>230</sup> reported here, preliminary results show that at least one of the conversion electrons in each pair cannot be attributed to a nuclear transition of  $\sim 70$  kev. Preliminary results are also reported from a study of Th<sup>228</sup> in which 42% of the  $\alpha$  tracks were associated with conversion electron tracks. (L.M.T.)

1249

THE ANGULAR CORRELATION OF THE CASCADE GAMMA RAYS FROM THE DECAY OF Au<sup>198</sup>. Carlton D. Schrader. *Phys. Rev.* 92, 928-31(1953) Nov. 15. (cf. NSA 7-3263.)

The angular correlation of the 0.411- and 0.64-Mev cascade  $\gamma$  rays resulting from the  $\beta$  decay of Au<sup>198</sup> to Hg<sup>198</sup> has been measured with scintillation counters. If only pure multiple radiations are assumed, the experimental data do not agree with theoretical calculations for any reasonable values of the spins of the relevant states in Hg<sup>198</sup>. They do agree well, however, with spins of 0, 2, and 2 for the ground state, 0.411-Mev state, and 1.09-Mev state of Hg<sup>198</sup>, respectively, if the first transition (0.68-Mev  $\gamma$ ) is assumed to be a mixture of 60% dipole and 40% quadrupole radiation and the second transition (0.41-Mev  $\gamma$ ) is assumed to be pure quadrupole radiation. The parities of all three states are the same, presumably even. These results are in general agreement with the internal conversion measurements of other investigators. (auth)

1250

ANGULAR CORRELATION OF THE GAMMA RAYS FROM Mn<sup>56</sup>. F. R. Metzger and W. B. Todd. *Phys. Rev.* 92, 904-6(1953) Nov. 15.



The angular correlations of the  $\gamma$  rays of  $\text{Fe}^{58}$  emitted in the decay of  $\text{Mn}^{56}$  have been studied by means of NaI scintillation counters. All three excited states of  $\text{Fe}^{58}$  involved in the decay of  $\text{Mn}^{56}$  were found to have spin 2, even parity. The spin of the ground state of  $\text{Mn}^{56}$  is probably 2, the parity even. The admixture of electric quadrupole radiation to the magnetic dipole 2-2 transitions is 2% for the 1.8-Mev  $\gamma$  ray and 8% for the 2.1-Mev transition, i.e., small compared to the admixtures in other 2-2-0 cascades. (auth)

1251

DECAY OF  $\text{Rh}^{106}$ . Bernd Kahn and W. S. Lyon. *Phys. Rev.* **92**, 902-3(1953) Nov. 15.

The  $\gamma$  radiations from 30-sec  $\text{Rh}^{106}$  have been examined by means of a NaI(Tl)  $\gamma$ -ray spectrometer. These consist of:  $\gamma$  rays of 0.516 (20.5%), 0.619 (10.4%), 0.88 (0.3%), 1.04 (1.7%), 1.14 (0.4%), and 1.54 Mev (0.2%) and several  $\gamma$  rays of higher energies with intensities of less than 0.1%. (auth)

1252

ALPHA-GAMMA ANGULAR CORRELATION IN IONIUM ( $\text{Th}^{230}$ ). G. M. Temmer and J. M. Wyckoff. *Phys. Rev.* **92**, 913-7(1953) Nov. 15.

The angular correlation between the  $\alpha$  particle leading to the first excited state of  $\text{Ra}^{226}$  at 67.8 kev and the subsequent  $\gamma$  ray to the ground state leads to a definite assignment of  $I = 2^+$  for this state. The correlation is weakened by what is believed to be an interaction of the nuclear electric quadrupole moment with crystalline electric field gradients in the source. The lifetime of the excited state is about  $1 \times 10^{-8}$  sec. (auth)

1253

NEUTRON-DEFICIENT ISOTOPES OF THALLIUM. I. Bergström, R. D. Hill, and G. de Pasquali. *Phys. Rev.* **92**, 918-23(1953) Nov. 15.

The activities of the K-capturing isotopes of  $\text{Tl}^{198-202}$  have been investigated. By means of  $180^\circ$   $\beta$ -ray spectrographs, more than 150 conversion lines have been observed. A new isomer of 1.9-hr half life has been found and assigned to mass number 198. There are three  $\gamma$  rays of 282.4, 260.7 (isomeric), and 48.7 kev associated with this activity. No Tl isomers, other than  $\text{Tl}^{198m}$ , or Hg isomers, other than the already known  $\text{Hg}^{198m}$ , were found. The first excited states in  $\text{Hg}^{200}$  and  $\text{Hg}^{202}$  were found to be  $2^+$  states. The level schemes of  $\text{Hg}^{198}$  and  $\text{Hg}^{200}$  are complex. (auth)

1254

TECHNETIUM OF MASS NUMBER 98. John K. Lerohl, M. L. Pool, D. K. Kundu, and R. A. House. *Phys. Rev.* **92**, 934(1953) Nov. 15.

By (p,n) reactions on enriched Mo isotopes, it has been found that  $\text{Tc}^{98}$  does not have a half life in the neighborhood of either 42 min or 2.8 days as had been variously claimed. (auth)

#### RARE EARTHS AND RARE-EARTH COMPOUNDS

1255

Ames Lab.  
THE FERROMAGNETIC PROPERTIES OF THE RARE EARTH METALS. J. F. Elliott, Sam Legvold, and F. H. Spedding. June 1953. 58p. Contract W-7405-eng-82. (ISC-378)

The magnetic moment of Gd was measured in applied fields of 4,000 to 18,000 gauss, and over the temperature range of 20.4 to 320°K. The ferromagnetic absolute saturation moment was found to be  $253.6 \pm 0.9$  cgs units. This absolute saturation moment corresponds to about 7.12 Bohr magnetons. The Curie point for Gd was determined by two different methods. The two determinations do not agree. The magnetic moment of Dy was measured in applied fields of 4,000 to 18,000 gauss and over the temperature range of 20.4 to 205°K. The susceptibility of Dy was shown to be

field-dependent in the approximate temperature range of 90 to 172°K. Below about 90°K Dy appeared to be truly ferromagnetic. The magnitude of the measured values of the magnetic moment of Dy indicates that the orbital angular momentum must contribute to the ferromagnetism. An absolute saturation magnetic moment of at least 8 Bohr magnetons was indicated by the data obtained in the temperature range of 31.25 to 80°K. The strange behavior of the magnetization vs.  $1/H$  curves of Dy was noted, and possible explanations were set forth. The magnetic moment of Er was measured for applied fields of 4,000 to 18,000 gauss and over the temperature range of 20.4 to 71°K. The susceptibility of Er was shown to be field-dependent below about 55°K. Erbium appeared to be truly ferromagnetic at 20.4°K. The magnitude of the measured values of the magnetic moment indicates that the orbital angular momentum must contribute to the ferromagnetism. The similarities and differences of the magnetic behavior of Er and Dy were noted. (auth)

#### SHIELDING

1256

Knolls Atomic Power Lab.  
NUMERICAL STUDIES OF NONAXIAL DISTRIBUTIONS FROM DISK SOURCES OF RADIATION. M. L. Storm and J. H. Smith. Aug. 1, 1953. 69p. Contract W-31-109-eng-52. (KAPL-966)

The double integral

$$D(z, a, \epsilon) = \int_0^a \int_0^{2\pi} G[(z^2 + \rho^2 + \epsilon^2 - 2\epsilon\rho\cos\theta)]^{1/2} S(\rho) \rho d\rho d\theta$$

is evaluated numerically by formulas developed in KAPL-918. The point kernel  $G$  and source strength  $S$  are so chosen that  $D(z, a, \epsilon)$  is the dose at a space point  $(\epsilon, z, 0)$  in an  $(r, z, \theta)$  coordinate system, the source being a disk of radius "a" centered at the origin and of constant source strength per unit area. Calculations are performed for  $G(R) \sim (1 + B\sigma R)e^{-\sigma R}/R^N$  for the cases ( $B = 0, N = 2, 3$ ) and ( $B = 1, N = 2$ ). Curves and tables are presented to illustrate the influence of physical parameters on  $D(z, a, \epsilon)$ . Special methods are developed to facilitate the application of general formulas derived in KAPL-918. Results are presented graphically for use in shielding design studies. (auth)

1257

Nuclear Development Associates, Inc.  
GAMMA RAYS RESULTING FROM THERMAL NEUTRON CAPTURE. Phillip Mittelman. Oct. 6, 1953. 10p. (NDA-10-99)

Available data on  $\gamma$  rays following thermal neutron capture in 35 elements or nuclides are tabulated so as to be in more useful form for those concerned with shield design. In some cases the number of photons has been determined, whereas in others only the intensity of the resolved lines are included. (L.M.T.)

#### SPECTROSCOPY

1258

California Inst. of Tech.  
FUNDAMENTAL RESEARCH IN SPECTROSCOPY OF SHORT WAVE-LENGTH X-RAYS AND GAMMA-RAYS. QUARTERLY REPORT [FOR] PERIOD JANUARY 1 TO MARCH 31, 1953. Jesse W. M. DuMond. 14p. Contracts AT(04-3)-8, Quarterly Report No. 2 and N6onr-244, T. O. 4, Quarterly Report No. 24. (AECU-2766)

Activities preparatory to installation of radiation sources, design of  $\beta$ -ray spectrometers, design of a photographic curved-crystal spectrometer for soft  $\gamma$  rays, development of a scheme for photographically recording the pulse-height



spectrum from a scintillation crystal delineated by appropriately controlled deflections on the two axes of an oscilloscope combined with high-contrast photography, and design changes in monochromators are reported. Preparations for precision x-ray measurements to obtain information regarding the  $L_{II}-L_{III}$  x-ray level differences of heavy elements are discussed briefly. (C.H.)

1259

California Inst. of Tech.

FUNDAMENTAL RESEARCH IN SPECTROSCOPY OF SHORT WAVE-LENGTH X-RAYS AND GAMMA-RAYS. QUARTERLY REPORT [FOR] PERIOD APRIL 1-JUNE 30, 1953. Jesse W. M. DuMond. 18p. Contracts AT(04-3)-8, Quarterly Report No. 3; N6onr-244, T. O. 4, Quarterly Report No. 25; and DA-04-495-Ord-444, Quarterly Report No. 1. (AECU-2767)

The arrival of 4 strong  $\gamma$  sources is announced. The  $\gamma$  spectrum of a  $Ta^{183}$  source was measured with a 2-meter curved crystal  $\gamma$ -ray spectrometer. A new recording device for a  $\gamma$ -ray spectrometer is described. The  $\beta$ -ray spectrometer was used to obtain information on the energy level of  $Li^7$  and  $Ta^{183}$  sources. The photographic  $\gamma$ -ray spectrometer was used to measure  $\gamma$  spectra of  $Ta^{182}$  and  $Ta^{183}$ . Preliminary results are reported in studies of the determination of the size and shape of sub-microscopic particles by long wave-length x-ray-diffraction methods. Measurements on uniform latex spheres are reported, and the application of these measurements to the calibration of electron microscopes is discussed. Progress is reported in obtaining equipment for use in measurements of the  $L_{II}-L_{III}$  x-ray level differences of heavy elements. (For preceding period see AECU-2766.) (C.H.)

1260

Ames Lab.

A NEW APPROACH TO DIRECT-READING SPECTRO-CHEMICAL ANALYSIS. R. K. Brehm and V. A. Fassel. Dec. 1953. 150p. Contract W-7405-eng-82. (ISC-430)

The optical, mechanical, and electronic aspects of a new type of direct-reading instrument for spectrochemical analysis are presented. A single multiplier phototube is used in combination with a rapid-scanning spectrometer. As the spectral lines cross the single exit slit, voltage pulses are generated by the phototube and are panoramically presented on an oscilloscope whose time-base is synchronized with the spectrum scan. The pulse heights are measured by converting them to "bursts" of constant-amplitude pulses whose number is proportional to the magnitude of the original spectral-line pulse. This is accomplished by means of a cathode-ray tube, a "comb-grid", and a secondary multiplier phototube. The pulse bursts corresponding to the lines whose intensity is of interest are separated by means of electronic gates. High-speed scalars and mechanical registers indicate the time integrals of the spectral-line intensities. Intensity ratios are automatically computed after the exposure and recorded on a variable span strip chart recorder, which may be empirically calibrated to read directly in per cent. Some typical applications of this direct-reading approach under flame, d-c arc and a-c spark excitation conditions are discussed, and other applications to multichannel-absorption or emission-spectroscopic measurements are suggested. (auth)

1261

Columbia Radiation Lab., Columbia Univ. ABSORPTION OF MICROWAVES BY OXYGEN IN THE MILLIMETER WAVELENGTH REGION. Joseph Oscar Artman. June 1, 1953. 88p. Contract DA-36-039-sc-42519. (NP-4948)

The spin reorientation spectrum of  $O_2$  in the millimeter wavelength region has been investigated both at high and low pressures with the untuned-cavity spectrometer. The

resolved  $O_2$  lines observed at low pressures corresponded to values of the rotational quantum number  $K$  extending from 1 to 19. The line-breadth parameters were found to be fairly independent of the value of  $K$ , averaging to 1.94 Mc/mm Hg. For several lines both the peak intensity  $\gamma_{peak}$  and the line breadth parameter  $\Delta\nu/P$  were independently determined. The product  $\gamma_{peak} \Delta\nu/P$  was found to agree to  $\pm 5\%$  with theoretical values which are expressed in terms of known matrix elements and physical constants. The ratio of the  $O_2-N_2$  broadening parameter to the  $O_2$  self-broadening parameter,  $\beta$ , was determined by observations on a number of individual lines to be  $0.90 \pm 15\%$ . Applicability of various proposed theories to  $O_2$  broadening has been examined in detail. The line breadth can be most reasonably interpreted as due to Van der Waals interactions of the London dispersion and exchange types. The absorption of  $O_2$  in dry air was measured at pressures of  $1/4$ ,  $1/2$ , and 1 atm. At these pressures, absorption is attributed to the addition of the many overlapping individual lines. A good fit to the experimental data was obtained from the Van Vleck-Weisskopf line-shape formula with an  $O_2$  self-broadening parameter value of 1.94 Mc/mm Hg and an  $O_2-N_2$  broadening ratio  $\beta$  of 0.75. The value of  $\beta$  is somewhat more accurate than the value measured at low pressure and is the appropriate value for calculating line breadths at pressures near 1 atm. The data obtained and formulas presented are useful in predicting atmospheric absorption of  $O_2$  under various conditions. This is illustrated by the presentation of  $O_2$  absorption in air computed at a temperature of 223°K and  $1/4$  atm. pressure. (auth)

1262

X-RAY ABSORPTION SPECTRA OF Ni, Cu, AND Zn IONS IN AQUEOUS AND NONAQUEOUS SOLUTIONS. E. E. [Ye.] Vainshtein and V. S. Kavetskii [Kavetsky]. Translated from *Doklady Akad. Nauk S.S.S.R.* 91, 775-8(1953). 4p. (NSF-tr-141)

An experimental study is presented of x-ray absorption spectra of Zn dissolved in the form of salts of different compositions in acetone, pyridine, water, methanol, ethanol, and glycerine; of Cu dissolved in glycol, water, methanol, and glycerine; and of Ni in solutions of glycol, water, and ethanol. The experimental data are discussed. (J.A.G.)

1263

THE HYPERFINE STRUCTURE OF HYDROGEN. R. Arnowitt. *Phys. Rev.* 92, 1002-9(1953) Nov. 15.

The two-body formalism of Schwinger is modified to consider the case of the H atom. The proton's anomalous moment is treated by adding a Pauli-type term to the Lagrangian. A perturbation theory based upon the Green's function is developed, and the first-order correction to the Fermi hyperfine splitting of the ground state is calculated. The method of calculation used is that of Karplus and Klein in their positronium work. Aside from the usual renormalizations encountered, an extra infinity appears in the calculation associated with the assumption of a point-anomalous magnetic moment for the proton. On the hypothesis that the proton's moment is actually distributed, cutoffs are inserted. The modified hyperfine formula leads to a new value of  $\alpha:1/\alpha = 137.0378$  for a cutoff at the meson length and  $1/\alpha = 137.0374$  for a cutoff at the proton length. (auth)

# THEORETICAL PHYSICS

1264

ELIMINATION OF DIVERGENCE IN QUANTUM ELECTRODYNAMICS. A. Akhiezer and R. Polovin. *Uspekhi Fiz. Nauk* 51, 3-40(1953). Sept. (In Russian)

1265

ON A SIMPLE PICTURE OF THE PHENOMENON OF NUCLEAR FISSION. Daniel Curie. *Compt. rend.* 237,



1401-3(1953) Nov. 30. (In French) (cf. NSA 7-1216)

More evidence is given to support the theory that the U nucleus is made up of a saturated core surrounded by a membrane of nucleons. The fission of a nucleus at  $Z = 47$  rather than  $Z = 50$  and the sharp drop in the fission yield curve at  $A = 139$  support the proposed U model. (J.S.R.)

1266

COMPATIBILITY OF THE EQUATIONS OF THE UNIT THEORY OF EINSTEIN-SCHRÖDINGER. André

Lichnerowicz. Compt. rend. 237, 1383-6(1953) Nov. 30. (In French)

The structure of the equations of the unit theory of Einstein-Schrödinger (so-called weak equations) is analyzed. The corresponding Cauchy problem allows, in general, a unique physical solution. (tr-auth)

1267

A NEW MODIFICATION OF CLASSICAL ELECTROMAGNETIC THEORY. A. Schild. Phys. Rev. 92, 1009-14(1953) Nov. 15.

A fundamental particle is treated as a unit charge whose rest mass and space-time coordinates are variables of its motion. Classical electrodynamics, in its action at a distance formulation, is obtained from an action principle which is simpler than the usual one. In this new action principle, the rest mass of a particle is varied as well as the coordinates. The rest masses of interacting particles, although not assumed constant a priori, become constants as a consequence of the equations of motion. Modifications of the old action principle can yield purely electromagnetic rest masses which are, however, the same for all particles. Similar modifications of the new action principle give purely electromagnetic rest masses to all charged fundamental particles. In this new modification of electrodynamics, particles interacting at small distances no longer have constant rest masses. (auth)

1268

ELECTROMAGNETIC MASS AND A PARTICLE MODEL IN DARLING'S THEORY OF ELEMENTARY PARTICLES. Hans Freistadt. Phys. Rev. 92, 1015-16(1953) Nov. 15.

A description of a particle in Darling's theory of elementary particles by wave functions of the form  $H_1^{\pm}(\kappa s)/\kappa s$  and  $H_1^{\pm}(\kappa s)/\kappa s [H_1^{\pm}(x)]$  is the Hankel function of the first kind of order 1,  $s^2 = c^2 t^2 - x^2$ ,  $\kappa = m_0 c/\hbar$  is discussed. It is shown that no current-charge density described by a conventional interpretation of these wave functions can exist. Hence, the classical interaction  $j^{\alpha} A_{\alpha}$  associated with these wave functions cannot account for the empirical correction for electromagnetic mass previously used by the author. (auth)

1269

NUCLEAR FORCES FROM P-WAVE MESONS. E. M. Henley and M. A. Ruderman. Phys. Rev. 92, 1036-44(1953) Nov. 15.

The nucleon-nucleon potential from meson exchange is related to a matrix describing the scattering of virtual and real mesons by nucleons. This meson-nucleon scattering matrix is calculated for p-wave mesons, using the model of Chew, which approximates experimental phase shifts for real mesons. The corrections to the  $g^2$  and  $g^4$  perturbation theory nuclear forces are evaluated. States involving the simultaneous existence of three or more mesons, none of which are absorbed by the same nucleon that emitted them, have been omitted in this treatment. Comparison of these and other results implies that this neglect is unjustified. (auth)

1270

NUCLEAR FORCES IN PSEUDOSCALAR MESON THEORY. K. A. Brueckner and K. M. Watson. Phys. Rev. 92, 1023-35(1953) Nov. 15.

The nuclear forces in pseudoscalar meson theory are evaluated using a nonrelativistic approximation to the relativistic interaction. The potential is obtained in a form which allows explicit evaluation of the contribution due to the multiple scattering of the virtual mesons between the two nucleons. An approximate expression for the potential, including the multiple scattering of a single meson, is obtained in closed form. For  $r < 0.5\hbar/\mu c$ , the multiple-scattering terms predominate, and a power series expansion of the potential is nonconvergent. On the other hand, for  $r > 0.5\hbar/\mu c$  the potential obtained can be approximated by the second- and fourth-order terms as obtained from perturbation theory. With these latter two terms and a phenomenological "repulsive core," quite satisfactory results are obtained for the low-energy properties of the two-nucleon system. (auth)

1271

THEORY OF POLARIZED PARTICLES AND GAMMA RAYS IN NUCLEAR REACTIONS. Albert Simon. Phys. Rev. 92, 1050-60(1953) Nov. 15.

The complete specification of the spin states of a particle of spin  $i$  resulting from a nuclear reaction requires a knowledge of all irreducible spin tensor moments  $T_k^q(|\kappa| \leq q \leq 2i)$ . A general calculation is made of the spin tensor moments arising from a nuclear reaction initiated by an arbitrarily polarized initial beam. All sums over magnetic quantum numbers are performed by the use of the S matrix and Racah formalisms. The results are expressed in terms of the G function which is related to the Fano X function. All selection rules follow from the properties of the G function. In particular, a generalization of the Eisner-Sachs selection rules are given. The problem of the detection of polarized particles is considered. The S-matrix formalism is extended to include the possibility of  $\gamma$  rays in nuclear reactions. Analogous formulas to those of Blatt and Biedenharn are given for the angular distributions of gamma rays. A simple recipe yields a general result for the polarization and angular distribution of radiation from aligned nuclei. Finally, the theory is extended to include the possibility of an arbitrarily polarized target nucleus as well. (auth)

1272

THE UNIVERSAL FERMI INTERACTION. E. J. Konopinski and H. M. Mahmoud. Phys. Rev. 92, 1045-9(1953) Nov. 15.

On the basis of the hypothesis that the same form of interaction acts among any spin- $1/2$  particles, it is interesting to apply the interaction law found for  $\beta$  decay to the muon processes. The application is beset by two types of ambiguity. The first is due to the uncertainty in measured values of coupling constants, and particularly their signs. The second arises from the various ways in which the correspondence between the particles of  $\mu$  and  $\beta$  decay may be taken. Arguments are presented that the unique correspondence established if two like neutrinos are ejected in  $\mu$  decay is the correct one. It is argued that previous interpretations of the universal fermi interaction have been unjustifiably broad. Only processes in which two normal particles (vs. antiparticles) are annihilated, and two created, should be expected. The positive muon must be treated as the normal-particle (if the neutron, proton and negatron are) in order to avoid the expectation that muon capture by a proton may yield electrons, contrary to experimental facts. The conclusion that two like neutrinos are ejected in  $\mu$  decay follows immediately. (auth)

1273

INTERACTION OF A NONRELATIVISTIC PARTICLE WITH A SCALAR FIELD WITH APPLICATION TO SLOW ELECTRONS IN POLAR CRYSTALS. Tsung-Dao Lee and David Pines. Phys. Rev. 92, 883-9(1953) Nov. 15.



A general variational technique is developed to study the effect of recoil on the motion of a nonrelativistic particle in a scalar field. The ground-state energy is determined, and the results obtained are shown to be exact in the limit of both weak and strong field-particle coupling. This method is applied to investigate the low-lying energy levels of a conduction electron in a polar crystal. The ground-state energy and effective mass so obtained are shown to be in good agreement with the results of Lee, Low, and Pines for the intermediate coupling strengths occurring in real polar crystals. (auth)

#### URANIUM AND URANIUM COMPOUNDS

1274

[Brookhaven National Lab.]

6.70 ev RESONANCE IN  $U^{238}$ . Jules S. Levin. Nov. 9, 1953. Decl. Dec. 9, 1953. 1p. (AEC-3604)

By means of the Brookhaven fast chopper, transmission curves were obtained for the  $6.70 \pm 0.06$ -ev resonance in  $U^{238}$ , 4 different thickness of natural U metal being used. For each sample the area above the transmission curve was measured between  $E_0 - \Delta E$  and  $E_0 + \Delta E$ , and the area

outside of this region calculated by means of the expression  $\sigma_0 \Gamma^2 = 15 \text{ (ev)}^2$ -b. These results were analyzed to obtain  $\sigma_0 \Gamma$  and  $\sigma_0 \Gamma^2$ , from which  $\sigma_0$ ,  $\Gamma$ , and  $\Gamma_D$  were obtained. These measurements are summarized in tabular form. (J.A.G.)

1275

PHASE TRANSFORMATION IN URANIUM. B. R. Butcher and A. H. Rowe. *Nature* 172, 817(1953) Oct. 31.

A U-Cr alloy (1.4 at.% Cr) was heated in vacuum in the  $\gamma$ -temperature range, cooled slowly into the  $\beta$ -temperature range, and then quenched to retain relatively strain-free polycrystalline  $\beta$  solid solution. After further heating in an oil bath at  $80^\circ\text{C}$  for several hours, microscopic examination disclosed that several plates of  $\alpha$  phase had formed in the  $\beta$  grains, presumably by a martensitic process. A Laue photograph of a  $\beta$  grain showed it to have two well separated  $\alpha$  plates. The orientations of the grain and plates were found relative to the surface plane of the specimen and a standard direction on the camera stage unit. The planes normal to the trace of the habit plane were determined for each plate and plotted as a great circle on the stereographic projection of the  $\alpha$  and  $\beta$  orientations. (L.M.T.)